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Report of the PSARC Ad Hoc Subcommittee Meeting on Marine Environmental and Habitat Issues March 10-11, 1997

J. Rice, Chair
Pacific Stock Assessment Review Committee (PSARC)
Pacific Biological Station
Nanaimo, British Columbia V9R 5K6

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PSARC *AD HOC* SUBCOMMITTEE MEETING
MARINE ENVIRONMENTAL AND HABITAT ISSUES
10-12 MARCH, 1997

The meeting was held in the Seminar Room, Pacific Biological Station, from 09:30 - 16:45 on March 10, and 09:30 to 15:30 March 11. The first day addressed aspects of marine environmental influences on fish stocks and fish production, in the specific context of approaches to stock assessment and advice on fisheries management. The second day addressed science aspects of the review and evaluation of Marine Protected Areas. J. Rice, Chair, PSARC, chaired the meeting. Attendees at each day's meeting are listed in Appendix 1.

Both topics were assigned to PSARC by RMEC, at the PSARC -RMEC meeting of 9 December 1996. Several memos went out to DFO staff in advance of the meeting, to clarify the intent of the meeting and the approach to be taken. These memos are included as Appendix 2 to this Report.

The Chair began the meeting with a brief review of why the meeting was called. RMEC has recognized there is strong evidence that the ocean environment does vary on many space and time scales, and that some of this variation has important effects on fish stocks and fisheries. Moreover, there is a public perception in at least some quarters that DFO stock assessments and advice to managers does not take adequate account of these influences. Hence we are perceived as not providing "best scientific advice" nor as being sufficiently precautionary in our approach to management. The diversity of statements being made on ocean variability and its use or lack of use in assessments and management advice is thought to be possibly contributing to these public perceptions. The goals of this meeting therefore are to review how ocean influences on fish stocks and fish production are being used in Regional assessments and advice from PSARC, identify areas for improved practice, if necessary, and consolidate a Regional perspective on these issues, to avoid presenting the false impression that DFO's work in this area is inadequate or in disarray.

To help structure the day's discussion, the Chair had prepared and distributed a page "Expanded Framework for PSARC Discussion - Monday, March 10" (Appendix 3). The attendees agreed that the meeting would begin with a series of presentations by individuals conducting research or assessments relevant to the overall theme. Those presentations would be for information, and to set a context for further discussions. Because they would not be the basis for PSARC advice, they would not be subjected to peer review at the meeting. Following the presentations the Subcommittee would discuss the three points in the "Expanded Framework for PSARC Discussion" document, to determine what consensus views could be reached.

Presentations:

Following are abstracts and figures of presentations made at the meeting:

1. **Doug Hay - Sea Surface Temperature Variation and the Timing and Distribution of Herring Spawn Locations in the Strait of Georgia.**

We examined herring spawn data collected over the last 60 years and sea-surface temperature data collected approximately over the same period. The total amount of spawn has not changed over time, and is at very high levels in recent years (1990's). The distribution of herring spawning in Georgia Strait has changed in the last 20 years, with more spawning in the northwest part of the Strait and less in the southeast. In general, there has been a concentration of spawn in fewer areas, and a decrease in the number of spawning sites. At the same time, the duration of the spawning season has shortened, with fewer earlier and later spawns than in previous years - although the mean spawning time is unchanged. Concurrently with these distribution and timing changes, sea-surface temperatures, as measured at the Entrance Island lighthouse, has increased. We compared spawn deposition with temperature. In one location, near Denman Island, herring spawn deposition has increased significantly. In nearly all other areas, herring spawn has not changed or has decreased. The results are consistent with the hypothesis that temperature can affect the location of spawning, but we point out that sea-surface temperature may not be the only explanation. There could be other causes, particularly those concerned with changes in age structure. In spite of the apparent increase in total spawn (or spawning biomass) we are concerned that continued warming could lead to further distribution and timing changes.

FIG. 1 The spawn index (smoothed) by mean Entrance Island sea-surface temperature in March for 10 of the most important sections in Georgia Strait

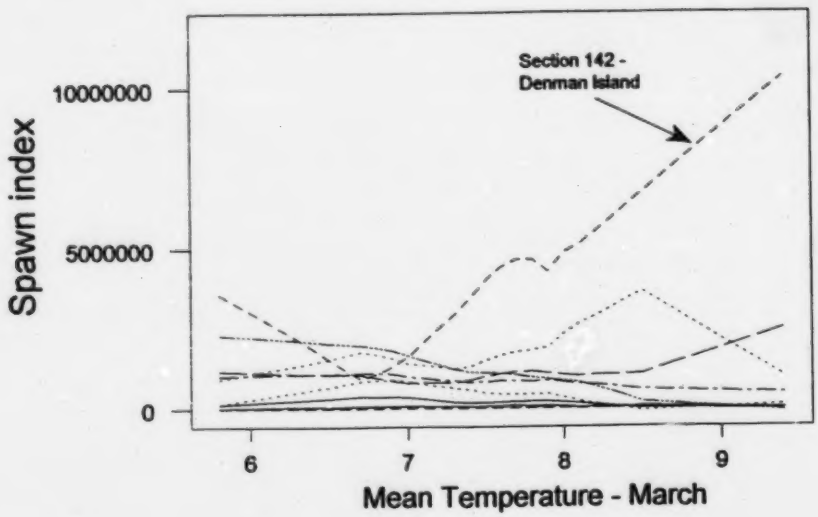
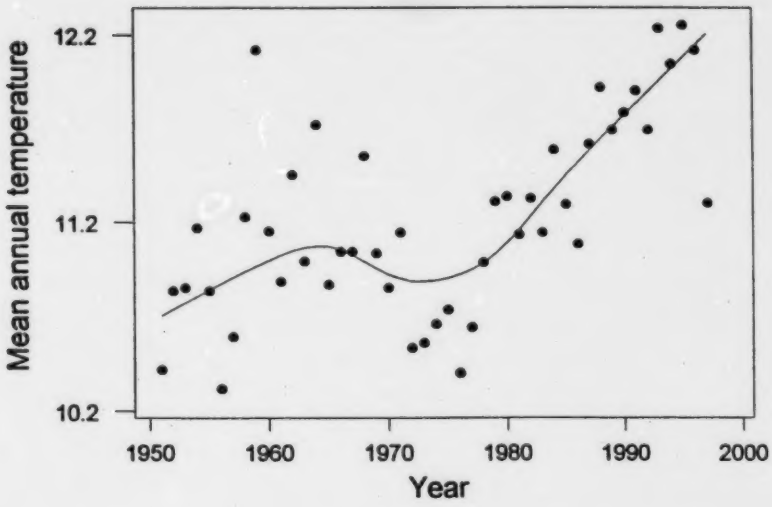


FIG. 2 **Mean sea-surface temperature, by year, at Entrance Island**



2. David Welch - Large Scale Changes in North Pacific and Steelhead population Variation.

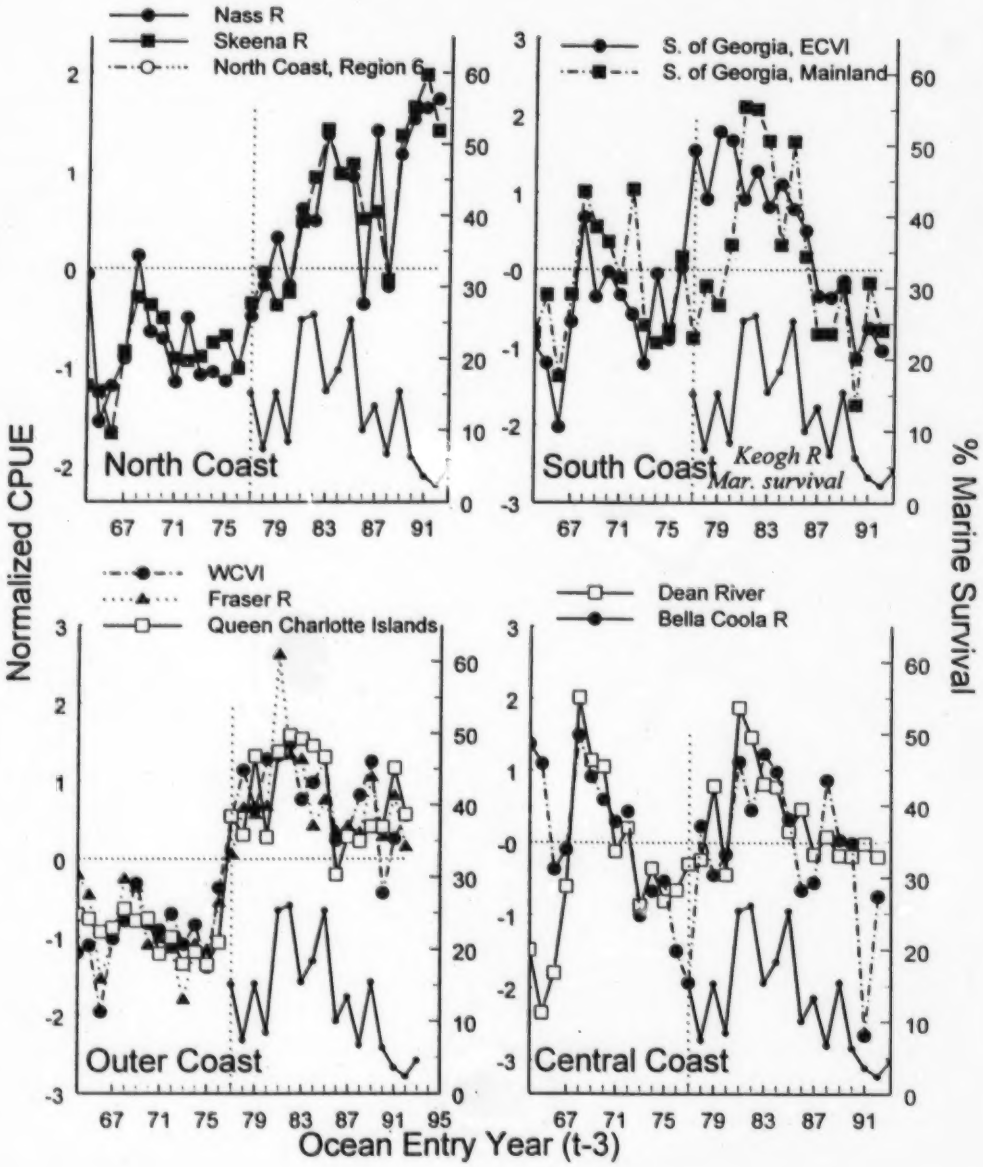
This document provides a review of evidence that sudden environmental changes occurred in the ocean about 1989-1990, and that the marine survival of British Columbia steelhead dropped sharply at the same time.

The changes in steelhead recruitment have distinct patterns of geographic and temporal variability that appear to be associated with large scale climatic changes that in the past have affected salmon populations around the Pacific Rim. Juvenile steelhead entering northern BC coastal waters appear to be encountering much better conditions for survival after 1990 than juvenile steelhead entering southern and central BC coastal regions. As a result, southern steelhead populations are declining. In at least some cases, past steelhead population sizes ***may not be sustainable even in the absence of fishing.*** The likely reason is that ocean productivity and therefore marine growth of steelhead suddenly declined in south-central B.C. Although this document does not review evidence for a similar effect on other salmon or groundfish species, it is possible that this mechanism will have similar impacts on other species whose pre-recruit life history stages occur in south-central B.C. coastal waters.

As a result of this climate shift, sustainable harvest rates for steelhead following the 1990 climate shift have dropped, and stock assessments based on data collected prior to this time will give misleading conclusions unless corrected for current

oceanographic conditions. Making this correction in a statistically rigorous fashion is extremely difficult because there is insufficient new data after the 1990 climate shift to make an accurate direct assessment, and the underlying links between climatic change and biological effects on salmon populations are not yet clear. An important first step is to recognize the potential for sudden changes in ocean climate to affect fish productivity, and to advise client groups that assessments will necessarily be significantly more uncertain than in the past.

FIG. 1 *B.C. Steelhead, Adult Returns*



3. Ian Perry - Effects Of Ocean Conditions On The Availability/Catchability Of Fish To Gear.

Changes in ocean conditions can have immediate effects on the distribution of fish and their availability to fishing gear, in particular, to survey gear. These changes can increase the variability of survey indices of abundance, thereby increasing uncertainties in stock assessments. Most common are "year effects" in survey time series, which are rapid changes in apparent fish abundance over time that are greater than would be expected from the normal population dynamics of the fish. Such changes are most likely to be misinterpreted when they occur in the most recent survey year, since there is little additional information to confirm the survey point. Changes in ocean conditions, e.g. changes in the proportion of the bottom that is covered by temperatures and saltiness that are "preferred" by particular species, may be a cause of these year effects. What is required is to (1) identify those commercial fish species which show significant associations with specific water mass conditions, and (2) measure these water mass conditions as covariates in conjunction with the fisheries survey. Inclusion of local ocean conditions with results from surveys may be a method to reduce variability in survey estimates of abundance and improve stock assessments.

4. Ron Tanasichuk -The Utility of Sea Temperature and Salinity as an Indicator of Euphausiid Productivity.

Euphausiids are an important prey item for commercially important fish species along the southwest coast of Vancouver Island (SWCVI). I have been studying the population biology and productivity of euphausiids (*Thysanoessa spinifera, Euphausia pacifica*) in Barkley Sound since 1991. The aim is to determine if euphausiids are affected by variations in ocean climate. These results will be used to test if variations in euphausiid productivity affect the abundance/productivity of commercially important fish species. These tests will follow an evaluation of how well euphausiid abundance in Barkley Sound reflects that for the SWCVI.

The productivity of euphausiid adults, the life history stage fed on by fish, has changed dramatically since 1991 (Fig. 1). The production of *T. spinifera* adults declined by 50% during 1992, an ENSO year (Table 1). It has continued to decline and in 1995 was 10% of the 1991 level. *E. pacifica* productivity started declining in 1993. In 1995, it was 17% of the pre-ENSO level.

Results of recent work on SWCVI herring growth that I have done suggests that changes in euphausiid abundance affected size-at-age of recruits. Fig. 2 show the scatterplot for mean mass-at-age 3 against parental abundance, which I used as an index of year-class size early in the life history. The outlier for the regression is for the 1993 year-class, the first one subjected to low euphausiid abundance during the entire pre-recruit phase of its life history.

Fig. 3 shows sea surface temperature and salinity anomalies for Amphitrite Point. Temperature anomalies show the 1992 ENSO event and suggest that temperatures in 1993 and 1994 moderated somewhat and were warmer in 1995. Salinity appears to have been stable from 1991 through 1994 and declined in 1995.

A comparison of the euphausiid productivity time series with those for temperature and salinity anomalies suggests that these oceanic measurements do not describe variations in euphausiid productivity. The initial expectation would have been that lower temperatures would be accompanied by higher euphausiid production, but this has not occurred. I suggest that euphausiid productivity trends are complicated by their interactions with predators. Pacific hake (*Merluccius productus*) is the dominant euphausiid predator. The large increase in biomass during the 1992 ENSO began the change in euphausiid productivity characteristics. Unpublished results show that hake has not changed its diet nor size-selectivity of euphausiids, although euphausiid abundance has declined and adult-sized animals make up a much smaller proportion of euphausiid populations. This suggests that the relationship between euphausiids as prey and hake as predators has changed because of the ENSO event. It appears that euphausiids exerted a bottom-up control of their predators, the prey were overwhelmed by high predator biomass during the warm water period, and now hake exert a top-down control of their prey.

Table 1 Annual total production (P, mg wet mass x m^{-2} x y^{-1}) and P:B ratios. The weighted P:B is the mean weighted by abundance of adults and subadults.

	Sub-adult		Adult		Weighted
Year	P	P:B	P	P:B	P:B
T. spinifera					
1991	18460	34.6	25932	3.0	4.9
1992	24999	43.5	12793	2.7	7.2
1993	3908	10.0	5396	3.3	4.6
1994	853	12.9	5638	2.5	2.7
1995	868	5.1	2871	3.2	3.5
E. pacifica					
1991	1862	11.6	8324	3.2	3.7
1992	38807	32.6	15711	2.6	7.5
1993	10177	19.1	14187	2.4	3.8
1994	478	7.2	3796	1.1	1.2
1995	1580	12.1	1407	2.6	4.4

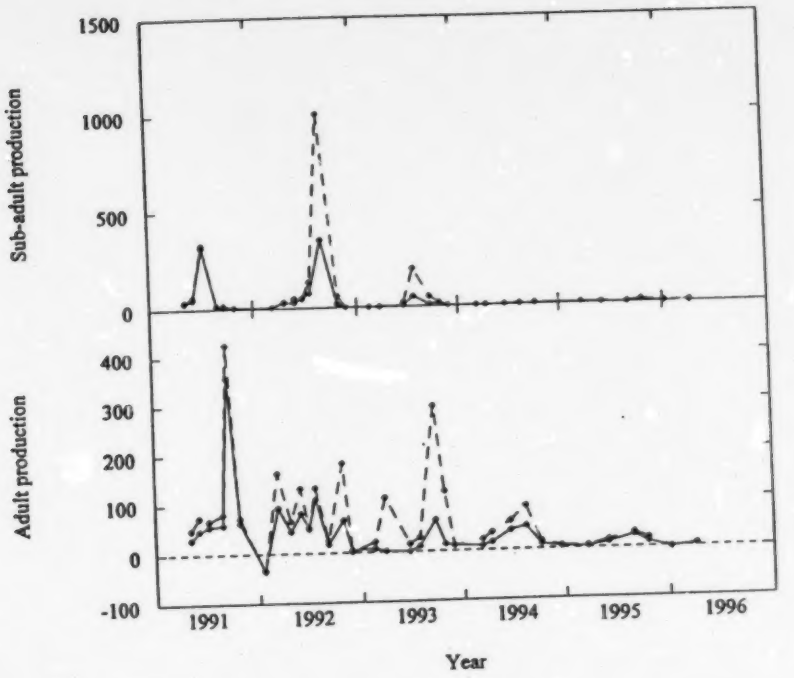


Fig. 1. Total daily production estimates (mg wet weight/sq.meter/day) for T. spinifera (—) and E. pacifica (—).

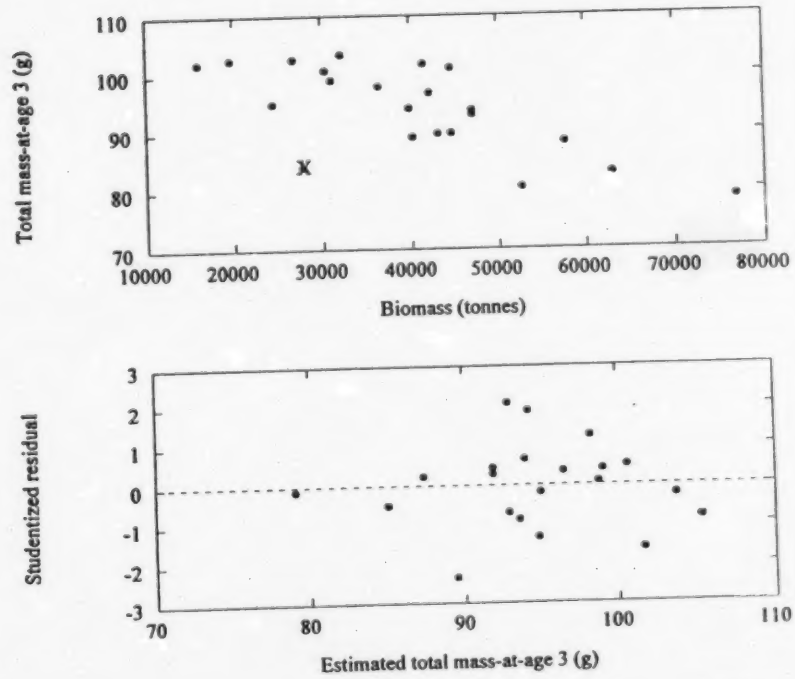


Fig. 2. Regression of total mass-at-age 3 against parental biomass for SWCVI herring. X - outlier.

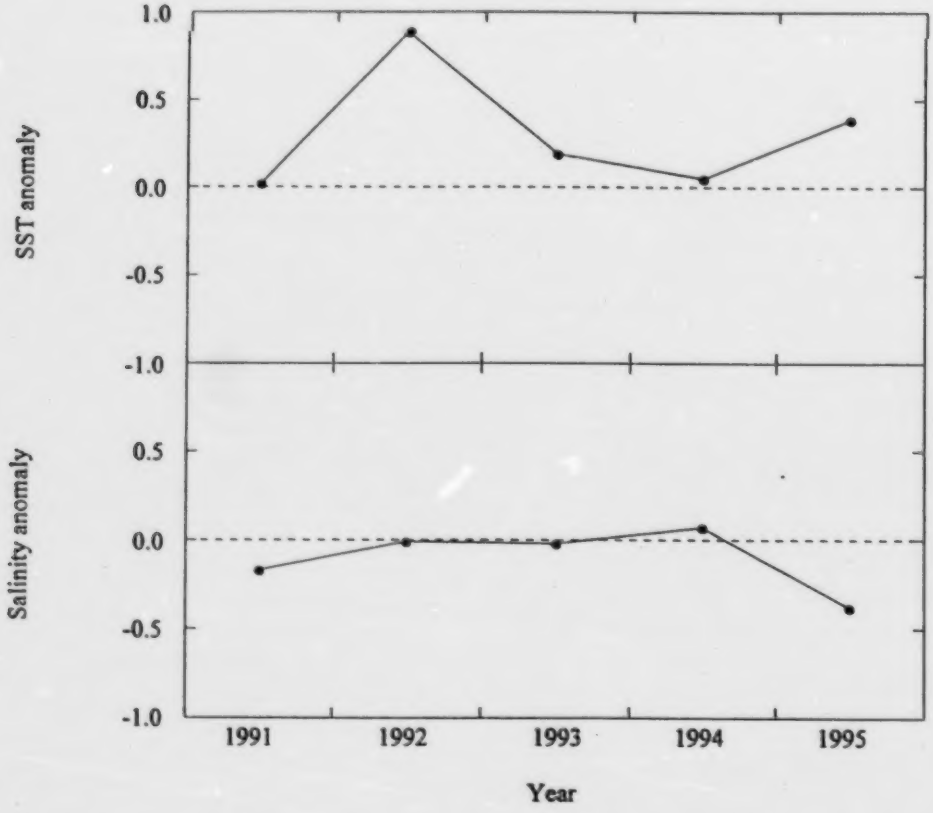


Fig. 3. Annual sea surface temperature and salinity anomalies for Amphitrite Point, 1991-95.

5. Dave Mackas - Seasonal and Annual Cycles, and Longer Phase Variation in WCVI Plankton.

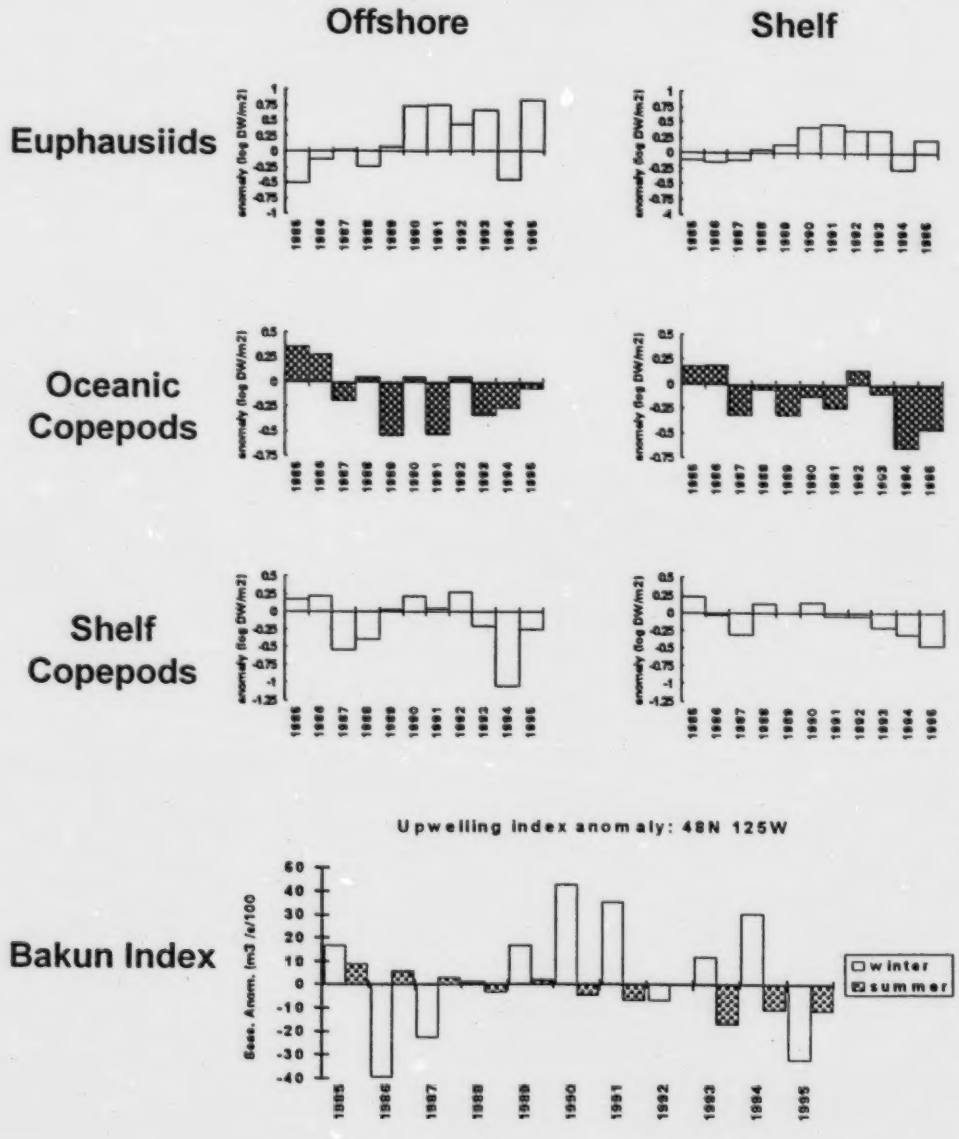
D. Mackas presented a brief update (through 1995) of the southern Vancouver Island zooplankton anomaly time series. The first part of this time series (1985-1992) was previously published (Mackas, D.L. 1995. Interannual variability of the zooplankton community off southern Vancouver Island. in R. Beamish, [ed], Climate change and northern fish populations. Can. Spec. Pub. Fisheries and Aquatic Sci. 121: 77-89.)

The zooplankton time series data show that (1) there are large (3-10x) fluctuations in size of major "food for fish" zooplankton populations; (2) these anomalies have a relatively large spatial footprint (bigger than that of seasonal cycle); (3) dominant time scale and phasing for anomalies is NOT one-year ENSO events; and (4)

anomalies of many taxa show a sign change and/or steep slope 1988-1990 -> evidence for a "regime change" in plankton productivity at the end of the 1980s.

FIG. 1

1985-95 Anomaly Time Series
West Coast Vancouver Island



(Mackas 1995, updated to include 1993-95 data)

6. D.M. Ware, Climate Variations and West Coast Vancouver Island Herring Production.

The productivity of the west coast of Vancouver Island (WCVI) herring stock undergoes large changes in response to interannual and decadal time scale variations in spawning biomass, and the state of the marine climate (a.k.a.Òclimate regimesÓ). Protracted warm regimes along the B.C. coast have occurred twice in this century, shorter warm and cool regimes have occurred alternately about every 11 years (Fig. 1). Recruitment is the most important process determining the biomass and productivity of B.C. herring populations. Stock reconstructions indicate that in the WCVI herring stock, year-classes born in cool years are two to three times as large, on average, as those born in warm years. Surplus production calculations indicate that the unfished carrying capacity of this population is about 100 thousand tonnes when the environment and ecosystem are in a cool climate state, but is less than half as large (ca. 46 thousand tonnes) during a warm state (Fig. 2). The population biomass is usually in transition between these two idealized ÒequilibriumÓ states, as it responds to interannual and decadal time scale variations in ocean climate, and fishing mortality. Research on the WCVI herring stock supports the following conclusions: (1) This stock can sustain catches exceeding 20,000 tonnes during cool climate regimes; however, in warm climate regimes the sustainable catch is less than 8,000 t ; (2) The current low stock productivity (and catches) are unlikely to improve until the prevailing warm climate moderates and returns to an average, or cool state; (3) The current size of the population (ca. 27,000 t) is close to the level which yields maximum productivity during warm climate states; (4) A 20% harvest rate is close to the maximum rate this population can sustain at this time.

Warm climatic conditions along the west coast of Vancouver Island are known to cause a higher influx of migratory predators (like Pacific hake and mackerel). Calculations suggest that the lower recruitment of WCVI herring in warm years is primarily the result of increased predation on juvenile herring, and possibly poor feeding conditions, which may also contribute to poorer survival. The other large migratory stocks of B.C. herring do not respond in exactly the same way to warm conditions because the juveniles in each stock tend to live in different ecosystems, which, in turn, are affected differently by temperature changes.

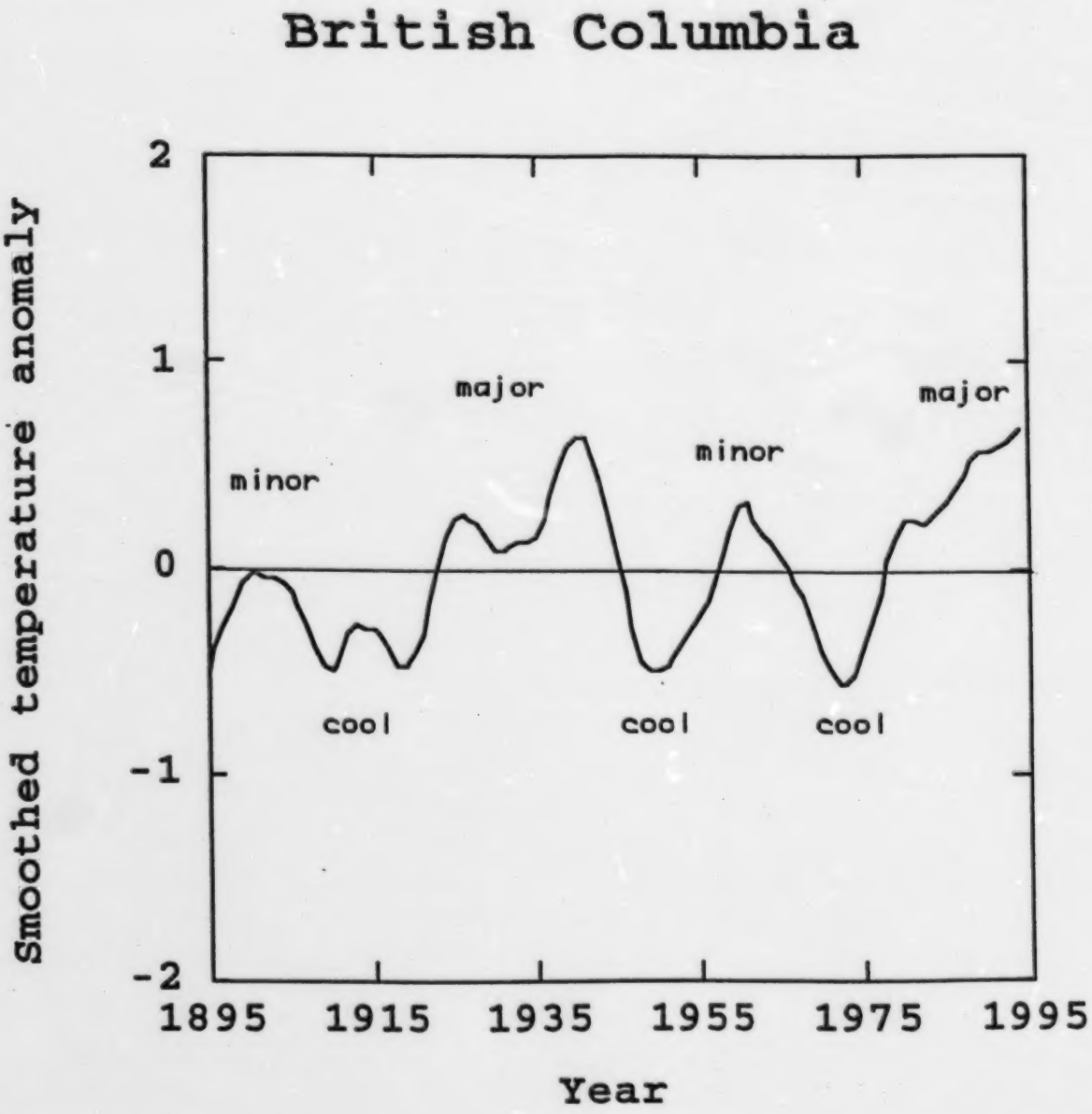


Fig. 1 Smoothed annual air temperature anomalies for coastal British Columbia (1895 to 1994). Coastal air temperature is a reliable indicator of sea surface temperature. The repeating pattern of minor warming...cool...major warming...and cool climates states is indicated. The horizontal line is the climatological mean, where the anomaly (defined as the deviation from the mean) is 0. A positive anomaly indicates warm conditions, and a negative anomaly cool conditions.

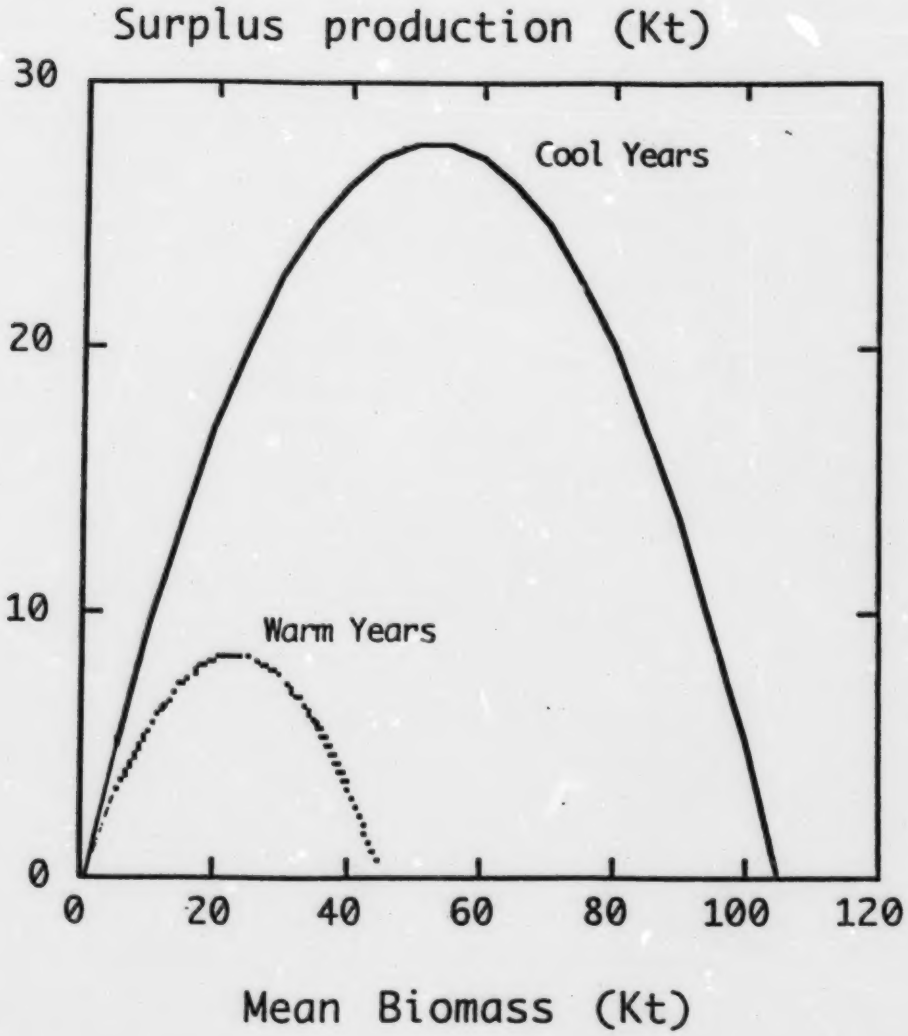


Fig. 2. WCVI herring surplus production curves during warm and cool climate states.

PSARC Discussion:

There was widespread agreement that there are numerous valid environmental indices, and numerous ways the ocean environment could affect fish stocks, however, no consensus was achieved with regard to identifying a modest number of environmental attributes to serve as leading candidates for use in assessments, nor on particular assessment attributes which should be featured in stock - environment analyses.

There was much greater concern with ensuring that the frameworks used in identifying specific relationships between stocks and features of the environment be both rigorous and rational. Models to be reviewed by PSARC must be clear, explicit, and testable. There was also concern that the issue not be treated as a "cookbook exercise". **Rather, the Subcommittee endorsed the concept that assessments were likely to require evaluation of several alternative models of a population. Alternative models might range from one which assigned no role for the environment in population dynamics, to models which gave the environment a dominant role.** Differences in the ways the alternative models fit the available data might shed light on what factors in the environment may be important, and what factors must be important. The first relationship found was not to be considered more legitimate than other relationships which fit the data comparably well, and with comparable statistical rigor.

There was general agreement that there would be greater confidence in stock - environment relationships which were observed for many related stocks and species. Low frequency (i.e. longer-term) variation in ocean attributes was of special concern to some members for several reasons, including the potential magnitude of effects, their potential widespread and long-lasting effects on many stocks and trophic levels, and the difficulty in detecting them statistically. Because degrees of freedom accumulate slowly in studies of low frequency variation, multispecies patterns and investigations are particularly important, even if assessments continue to be done at the single species or stock level. There were sound arguments made for paying particular attention to "early warning signs" of large scale changes in the ocean, but no methods were specified for identifying conclusively what those signs would be, nor how to monitor for them.

The discussion also highlighted that there were two kinds of extrapolation which may occur:

- a relationship may be found on a very coarse, aggregated level and the Department needs to know what it means for individual stocks, or
- a relationship may be found in a detailed study of one stock and the Department needs to know how widely applicable the relationship is.

Both types of extrapolation cause scientific anxiety, but are nearly inescapable with current information, research resources, and needs of fisheries managers.

There was general agreement that assessment models using environmental features should be constrained not just by statistical considerations, but also by the life histories of the species and the quality of the fisheries-dependent data. Some participants argued that it is inappropriate to use aggregated catch as the "population" variable when modelling stock dynamics, without explicitly including sources of variation other than ocean climate (e.g. escapement, freshwater survival) in the productive model using aggregated catch as a dependent variable. Other participants stressed that catch data are often the only data available, and not using them means not looking at all for effects which may be important. With regard to using estimates of primary or secondary productivity instead of physical attributes such as temperature, salinity or freshwater runoff, it was argued that because the productivity attributes are "closer" to the fish stocks in terms of population dynamics mechanisms, the relationships might be tighter. Many members argued however, that the variance of the biotic attributes is sufficiently complex in space and time that measurement error in the variables outweighs any gain in reality of mechanisms.

With regard to assessment parameters, there was general agreement that environmental influences should be looked for in recruitment series, weight- or length-at-age, and in survey time series. It was noted, though, that much of this work is being done already. However, some argued that if the primary investigations are at the scale of individual stocks, important signals may be missed. There is a need for assessments, or at least monitoring, of more integrative attributes of the marine ecosystems. **Many thought DFO was already detecting changes in assessment parameters due to environmental influences relatively well, and also doing fairly well at partitioning variability among causes, including fishing, ocean environment, and (for salmon) freshwater environment at pre-adult stages. The weak link at present is in how we interpret these changes in the context of advice to managers**.

With regard to interpreting effects of environmental events on fish stocks, two specific events were considered: ENSO events and the possible regime shifts in the late 1940s, about 1977, and possibly between 1989 and 1991.

- There is fair but imperfect ability to predict ENSO events several months in advance. **Assessment scientists on some stocks, such as WCVI herring and sockeye, felt that if an ENSO were predicted, they would know how to modify PSARC assessment advice to accommodate the likelihood of the event. Assessments of many other stocks would not be able to use the prediction in an empirical way even if it were available**. Serious concerns were expressed about the amount of hand-waving and use of buzz-words involved in pronouncements on some environment effects on fisheries.

- With regard to advice on consequences of regime shifts, there was no consensus on how well we are using the evidence at present in PSARC advice, nor on ways to improve practice. It was agreed that it is unrealistic to expect to be able to forecast decadal-scale changes in the environment. However, a goal of detecting regime shifts within two or three years of their occurrence was realistic. **It was agreed that PSARC cannot assure RMEC that we will not be "blind-sided" by an unexpected major change in the ocean environment. However, such a failure to predict would not be the result of lack of due diligence in the monitoring of the ocean or assessment of stocks. It was suggested that the topic of decadal-scale variation of the ocean environment, including its detection and use in stock assessments and advice, might be an appropriate topic for a National Workshop, sponsored under the new CSAS program.**

The Subcommittee further noted that in many cases where a major environmental signal may be present in stock assessment parameters, PSARC cannot tell if the climate influence is on high-seas, coastal, or fresh-water life history stages. Where it is possible to partition effects it is because we have high-quality time series. However, this situation gives a small number of salmon stocks a great influence on all salmonid advice. This is another justification for **PSARC to support development and maintenance of time series on well-studied rivers and streams, but also to assign priority to evaluating the degree to which these data rich systems are representative of conditions and relationships more widely.**

The discussion continued with a review of what environmental data series were available for use in assessments. The list quickly became very long, and most of the series can be summarized on many space and time scales. Some general guidelines were identified for useful space and time scale for summary indices, such as:

- match measures spatially to existing key-streams sites.
- match measures in space and time to existing survey series, such as Hecate Strait in May/June

Overall, providers of environmental data should use some sense in what is meaningful for the environmental feature. The provider should state the scale clearly and keep the series up to date. **It was agreed that the PSARC assessment subcommittees each would discuss potentially important environmental indices as an agenda item of their next scheduled meeting.** This is understood not to be a call for a wish list, but an attempt to be both proactive and efficient in the collection, management, and use of environmental data. **Prior to the Subcommittee meetings, Ocean Sciences Division staff will attempt to prepare a handout on what environmental data series are available now, and how to access them (This handout is includes as Annex 5; distributed at the meeting). In particular, Subcommittee Chairs and StAD line managers should alert staff to the PICES**

website on time series of environmental data, accessed at: http://pices.ios.bc.ca. It was further noted that although some environmental time series are available, time series on anomalies of stock reconstructions relative to stock indices from surveys or fisheries are not available. **Subcommittees will be asked to begin building up data bases of stock indices, assessment reconstructions, and anomalies between the two time series, so scientists working with environmental data can access information on the discrepancies which are in need of explanation.** It is understood that some of the these data bases may require controlled access, and such details are to be worked out as a line management issue.

The concluding discussion returned to the issue of making assessment advice useable for fisheries managers. **It was agreed that the goal for assessments should be to explore multiple scenarios, addressing possible fisheries and environmental forcing variables in diverse ways. Only by exploring multiple models will it be possible to begin to identify possible future states for a stock under different possible environmental conditions, estimate likelihoods and risks associated with each state, and the possible consequences of alternative management actions.** It is important that all this work be done with a high level of statistical rigor, and not pick results to fit preconceptions.

In forecasting the Region is already moving to a more risk-oriented framework for forecasts and advice. This on-going change will accommodate consideration of possible environmental influences on fish stocks readily, and such factors have been included in some assessments already.

MARINE PROTECTED AREAS MEETING MARCH 10-12, 1997

The meeting began with opening remarks by Jake Rice, Chair, PSARC; John Pringle, Head, Marine Environment and Habitat Sciences Division, Science Branch; and Rick Harbo, Harvest Management, Fisheries Operations Branch.

Rice reviewed the request from RMEC to have PSARC discuss marine protected areas (MPAs) (PSARC - RMEC meeting, December 1996). It was stressed that PSARC was only asked to consider biological and conservation aspects of marine protected areas, and not social or economic rationales or impacts. RMEC acknowledged that proponents of MPAs may assert they have a number of potential conservation benefits to them, and sought advice from PSARC on several issues:

- What types of conservation benefits may be obtained from MPAs?
- What attributes should an MPA possess in order to make it likely to receive each of the conservation benefits?
- What process should the Region use in evaluating MPAs, to ensure that the biological and conservation consequences of a specific MPA are understood as fully as possible with the information available?

It was understood that RMEC wishes to ensure that each candidate MPA be evaluated objectively and rigorously, with the Department supporting MPAs which make an appropriate contribution to delivering DFO's mandate for conservation of fish stocks, habitats, communities, and ecosystems, without unduly removing opportunities for sustainable sport and commercial fisheries.

Pringle noted that the Department as a whole, as well as the ME&HS Division were lagging behind proponents of MPAs, with regard to many aspects of the science and implementation of MPAs. MPAs have significant momentum in some client groups, and DFO scientists and managers face special challenges ensuring the science aspects of MPAs are of high quality. He endorsed the need for peer review of MPAs, both at the general planning stages, and when individual MPAs are being evaluated.

Harbo noted that DFO had not been aggressively proactive on MPAs, and we are functioning in a reactive mode. Many candidate MPAs are likely to be small and it is unlikely that DFO will be able to measure their individual (or possibly cumulative) effects. Moreover, some may be proposed more for social and recreational effects than for conservation effects. Notwithstanding these concerns, DFO managers are likely to be asked to be involved in negotiating the establishment and management of all types of MPAs, and in obtaining concessions from resource users.

There was some discussion of the mandate and objective of the day's meeting, following these introductory remarks. However, there were no substantive changes to the outline and questions distributed in advance of the meeting.

As a specific approach, the group agreed to begin with a presentation that Glen Jamieson (ME&HS Division) made at the UBC Symposium on the Design and Monitoring of Marine Protected Areas (February 20-22, 1997). That presentation would be followed by reports on the UBC Symposium by three individuals who attended (Jamieson, Rice, Heizer), reports on the Parksville Forum on MPAs held March 7-9, and then review of the three questions posed to PSARC. The review would be structured around the Summary and pages 10-15 of the document "Toward a Marine Protected Areas Strategy for the Pacific Coast of Canada" distributed at the Parksville Forum.

The Abstract of the Jamieson and Levings presentation to the UBC Symposium states:

Marine Protected Areas in Temperature Waters: Conservation of Biotic Physical Structure versus Habitat and its Production Potential by Glen S. Jamieson and Colin D. Levings

In terrestrial environments where both light and liquid water are available, rooted vegetation predominantly structures ecosystems and determines habitats. In shallow

nearsurface marine waters in tropical regions away from upwellings, a typically stable thermocline results in relatively low productivity, and animals, notably reef-building corals with symbiotic algae that collectively deposit calcium carbonate to build colonies, provide a long-lasting physical structure for ecosystems. In shallow temperate marine waters, nutrients are generally less limited because of regular deep-water replenishment, and biotic sea floor physical structure is largely determined by sea grasses and algae. In all three environments, greatest biodiversity is typically associated with structural species providing the most complex, long-lasting habitats. Coral reefs and forests often take centuries to fully develop, while temperate marine plant communities are relatively ephemeral, being comprised either of annuals or species living only a few decades at most.

Protected areas on land and in tropical waters often protect obvious, long-lived structural life forms (e.g. coral reefs and forests) rather that a specific physical habitat per se. In temperate waters, however, physical habitat, and its potential community structure, are more often the focus of conservation. Dyking, harbour construction and so on can completely destroy historic nearshore habitats, many of which are considered rare (e.g. estuaries). Documenting the functional importance of a portion of a large area of perceived similar habitat is logistically difficult, and consequently seldom attempted. Annual settlements of benthic species are often patchy and sporadic, with no obvious area deemed exceptional. Loss through attrition over time may be so gradual that real loss is not readily perceived. There are also few, if any, measures of the particular role a portion of a habitat had in a given year for important highly-mobile bird or marine species that are only seasonally present. Collectively, this makes it relatively difficult to use science to assign priority status for protection to many specific geographical areas. This lack of empirical data to help rationalize optimum size and location of potential temperate marine protected areas (MPAs) means that subjective criteria and lobbying by interest groups may be the main basis for establishing many MPAs in the short-term. Designation of an arbitrary percentage of a region's habitats for protection may be the most pragmatic short-term approach, but this should be coupled with a long-term monitoring commitment to evaluate if identified objectives are being achieved.

Because the paper is under review for publication in Symposium Proceedings, and is not the basis for specific PSARC advice, it was not reviewed formally by the Subcommittee, although there was some discussion following the talk.

Jamieson's report from the overall UBC Symposium noted the discussion group on MPAs in British Columbia concluded:

- a representative network of no-take areas should form the core of a Pacific Coast system of MPAs;
- No-take minimizes human impacts on all species and fundamental ecosystem processes;

- All ecozones should be represented, with replication where possible. This is desirable on grounds of logic, ecological objectives and, community participation;
- Larger MPAs are likely to provide more conservation benefits than small ones, but it is important to be realistic. The spatial arrangement of MPAs will be important;
- Buffer zones around no-take zones are useful;
- Current science suggests as much as 50% of a stock may be protected without producing a decrease in yield from the areas remaining open;
- MPAs must be effectively managed with strong community buy-in, if they are to realize their potential benefits.

Rice's report from the UBC Symposium noted the papers presented indicated:

- Few presentations and discussions actual addressed "design and monitoring" directly, although that was the theme of the workshop;
- Proponents often do not differentiate science and advocacy roles;
- It is often difficult to obtain a clear statement of the objectives of establishing an MPA;
- Some no-take MPAs have been conclusively shown to have increased the size, biomass, and age composition of key species. However other species show lower abundance inside the MPA than on adjacent areas. There were significant science challenges to partition effects of MPAs on abundance among habitat, fishing, and interactions among fish;
- Habitats of MPAs closed to bottom gears differed from habitats routinely trawled. Some Symposium participants equated change with damage. There are even greater science challenges in evaluating what sorts of "changes" are "damage";
- Some papers explored the value of no-take MPAs as "insurance policies" against failure of fisheries assessment or management outside the protected area. All models were easy to criticize and none were based on data from temperate ecosystems. However, a common answer was that to obtain significant insurance benefits, at least 40%, and probably 60% of the stock would have to be within a no-take zone;
- No-take MPAs must be <u>fully</u> no-take, in order for many of the biological and conservation benefits to be realized;
- If the proportion of the stock inside a no-take zone was large enough for "insurance" benefits to have a high probability, then risk to the stock was almost completely insensitive to exploitation rate on the portion of the stock outside the zone;
- Most models and discussion assumed the fishing industry would inevitably operate within a "tragedy of the commons" mode, unless they were restricted by externally imposed constraints.

Heizer noted the other speakers covered the main points of the Symposium. He highlighted a couple of particularly striking examples of MPAs with significant biological & fisheries effects, including copper rockfish and lingcod in Puget Sound, and seahorses in the Philippines. In both cases the MPAs were small, there was strong community involvement in their creation and management, and the species showing benefits were fairly sedentary as adults.

There was some discussion of the Symposium and the examples presented. Key points to the Subcommittee included the need for strong community support, the importance of no-take restrictions in the examples, and the sensitivity of any estimates of fisheries benefits to the assumed rate of transfer of fish out of the protected area into areas open for harvest.

There was some discussion of the nature of the Parksville Forum, and the relation of the Draft Discussion Paper distributed there to the DFO national Discussion Paper "An Approach to the Establishment and Management of Marine Protected Areas Under the Oceans Act." It was noted that the "Towards a Marine Protected Areas Strategy" was tabled as a "made in BC" approach to MPAs, with support from both the federal and provincial governments. Although it was clarified that there are many pieces of legislation which include provisions that allow protected areas to be created, for the purpose of the PSARC review at this time, the Parksville document would be the basis for discussion, rather than the legislative basis for MPAs.. It was further noted that the Forum Document addresses a wide range of MPAs, and not just exclusive no-take areas.

PSARC reviewed the five Benefits of Marine Protected Areas on pages (i) and (ii). It was agreed that only the first three items were within the mandate of PSARC:

Protect biodiversity and ecosystem structure, function and integrity;
Improve fishery yields; and
Expand knowledge and understanding of marine ecosystems.

The Subcommittee noted the following short-comings in the text for the proposed benefits, from the perspective of PSARC's mandate :

- To a large extent the benefits pre-suppose the existence of non-extractive users who will experience the benefits. This will be a problem for areas where there are fishers but few local communities, such as the west coast of the Queen Charlotte Islands. The Regional approach to MPAs must match constituency to benefits explicitly.
- To measure progress in science it is necessary to have effective contrast between non-impact and impacted. An MPA by itself will NOT increase understanding.

- The Oceans Act mandates DFO to restore damaged ecosystems or habitats, and the federal Discussion Paper acknowledges the role of MPAs in that task. The Forum Document does not mention that point.
- The promise to *'improve fishery yields"* is questionable, and sounds like the early promises for salmon enhancement. The Department should not suggest an undue level of confidence in the effectiveness of MPAs, when there are few Regional precedents, and great uncertainty about the causal mechanisms responsible for observed status of most stocks.
- The Benefits section needs to acknowledge that even if an MPA is effective in increasing abundance of some intended species, other species may suffer declines in abundance, or be excluded completely. Allowing 'natural ecological processes" to operate does not lead to every species becoming abundant; in fact, biodiversity could decrease.
- The Forum document does not mention a role for MPAs in protecting sensitive habitats. Although MPAs alone are not adequate to ensure protection of sensitive habitats, they can be an important tool.

The discussion on specific shortcomings of the Benefits section identified some more general Subcommittee concerns. These include:

- The concept of 'biodiversity" means many things to many people. It is appearing in many DFO statements, and even the science community does not agree on what the term means, nor on how to measure it. There are likely to be significant misunderstandings with clients in the future, as the Department is required to become more accountable for actions to promote or conserve biodiversity. **The Region needs to be fully integrated with initiatives on this topic at the levels of the Department, and the international scientific community.**
- The issue of active management within an MPA, particularly a no-take MPA, will be very important. **The Region needs to work with stakeholders to develop a clear policy on this issue, before Science or Operations are asked to intervene in an MPA to steer "natural ecological processes" towards some specific goal**.
- Many of the phrases in the document were thought to be high public appeal but were not scientifically grounded. Science does not possess the knowledge implied by many of the phrases, nor is it likely to be able to acquire the knowledge in the near future. **The Department needs to ensure the public has realistic expectations of what support will be available for MPAs during both the proposal and implementation stages. There must also be realistic expectations for the time-course required to achieve benefits from MPAs, if the benefits do accrue**.

Overall, the Subcommittee concluded it would be valuable to include a paragraph early in the Forum Document which introduces a note of caution with

regard to MPAs. They are not a sweeping solution to all fisheries management problems, but one of many tools to be used in the protection of habitats and conservation of fish stocks, communities, and ecosystems. To achieve the potential benefits of MAPS may require a much larger science foundation than exists at present by the Department, partners, and clients. Many decisions will be made in a domain of great uncertainty, and a number of years of study will be required before effects can be evaluated.

Goal 1: Management Regimes

The Subcommittee reviewed the proposed Management Regimes briefly. There were questions about whether a no-take area would be closed to aboriginal uses for food and ceremonial purposes, and what types of non-harvesting activities would be permitted. **Although these are not science issues, there will have to be a clear policy developed before it will be possible to evaluate the consequences of an MPA. PSARC also notes that the Resource Conservation category is not justified on biological grounds**. If the Department meets its basic mandate, it is achieving the objectives for this category of closure.

The Subcommittee tried to deal in detail with an evaluation framework for review of proposed MPAs relative to the goals and objectives in section 5.0 of the Forum Document. This proved not to be possible. Two general points did emerge from the discussion.

First, evaluating an MPA has many similarities with evaluating an Environmental Impact Assessment. In the case of MPAs, the evaluation is of the consequences of ceasing to conduct a class of activities, particularly fishing, rather than starting to conduct an activity. **PSARC should work with the ME & HS Division to draw in the body of expertise on EIS evaluation, to determine the extent to which that approach can be used to evaluate the biological effects of MPAs.**

Second, MPAs can be proposed for many reasons. Not all will require evaluation on biological grounds. Even MPAs proposed to achieve the first three benefits in the Forum Document may have diverse properties and purposes. **For every candidate MPA, the proponents must state the specific objectives of the MPA clearly. Otherwise it will be impossible to conduct a scientific evaluation which will be consistent, rigorous, objective, and credible to both the Department and partners.**

PSARC was pessimistic about its ability (or ability of any other body) to conduct a credible and rigorous review of the scientific basis for at least some MPAs proposed to achieve Goal 1: REPRESENT MARINE BIODIVERSITY, ECOSYSTEMS, and SPECIAL NATURAL FEATURES. In a trivial sense, any protected area will protect some degree of biodiversity, some portions of an ecosystem, and some special features. Judgments of which types of biodiversity, which ecosystems, and which

features are "special" involve values that are not wholly objective and empirical. Many problematic terms are appearing in these documents and elsewhere, as both the Department and clients address more multispecies and ecosystem issues. **It is essential that the department develop a "dictionary" of operational terms for concepts used in discussion of biodiversity and "special ecosystems". The StAD and ME & HS Divisions should work together on this task, and include meaningful input from Operations and Enhancement.**

If the intent of a network of MPAs is to focus on representative features and ecosystems, there must be a clearly established reference framework. It was noted that both DOE and the province are developing categorizations of marine "ecozones" and "ecoregions". These categorizations will likely to be influential on what areas should be included in a network of MPAs. Although DFO Science has had minor involvement in developing the Provincial initiative, the scheme has not received independent peer review.

The provincial classification proposals need to be subjected to science peer review, with strong DFO participation, prior to DFO accepting its use as a framework for "representative" ecosystems. PSARC would be a logical forum for that peer review. The PSARC review would be open and transparent, with provincial, academic, and public involvement, while maintaining a high scientific standard.

In some cases MPAs will be proposed where DFO and proponents do not have enough knowledge to conduct a scientific evaluation of the potential biological and fisheries consequences, nor can they expect to acquire it in a timely manner. In those cases DFO must make its position clear, and not go through the motions of a science review, when such a review is impossible.

Where information does warrant a review, the Department must make it a priority to apply all the available knowledge, from all Divisions and Branches of DFO, plus experts from outside government. Evaluation criteria will vary from case to case, but should be made explicit as early as possible in each case. The ability to set valid evaluation criteria for a specific MPA will be dependent on the clarity of objectives in the proposal. For example, evaluation of an MPA proposed for "protection of endangered species" would consider suitability of habitat, size of area, life history stages protected, etc.

Several points arising in discussion of this goal led the Subcommittee to agree **there is sufficient justification for the creation of a Habitat & Ecosystem Subcommittee of PSARC. This Subcommittee should have wide membership within, and outside DFO.**

Goal 2: To Conserve Fisheries Resources

The Subcommittee had more success discussing an approach to evaluating MPAs proposed for GOAL 2: TO CONSERVE FISHERIES RESOURCES

Although the meeting was not undertaking an edit of the Forum Document, **it was agreed that bullet 2: "providing conservative fisheries management regimes that limit destructive or indiscriminate fishing practices" should be removed from the text.** The bullet implies that without MPAs fisheries management regimes may not be conservative, and destructive or indiscriminate fishing practices may be unlimited. This is a false perception.

For candidate MPAs with objectives falling under Goal 2, the documentation should identify which stocks are intended to benefit from protection. The PSARC Subcommittee responsible for review of those stocks would provide a major portion of the review of the biological aspects of the MPA. As with review for Goal 1, the PSARC review would be open and transparent, with participation from outside DFO. Normal scientific standards of peer review would be followed. The particular criteria for evaluation would depend on the specific objectives of the MPA.

It would be valuable if DFO could use the multi-stakeholder process to alert proponents of MPAs to several points:

- Proposals should specify data collection components as part of the overall management plan for the MPA. These components should include activities which facilitate measuring the distributed benefits of the MPA, as well as changes within the boundaries of the MPA. Those measures, in turn, might assist in preliminary evaluation of the proposal, and as well as build a knowledge base which will make evaluation of later proposals easier. They also might allow measurement of progress towards achieving the objectives of the MPA, and facilitate future evaluations of the necessity for various provisions in the MPA management plan.
- Particularly in no-take MPAs, it is important that clients understand the requirements of monitoring programs. Many forms of monitoring and data collection cannot be done without some mortality. If monitoring programs must not cause mortality or habitat disturbance, it is likely that programs will be much more costly, and data will have much higher uncertainty.
- When an MPA removes a portion of a stock from fishing, usually the TAC will have to reduced, at least in the short term, if fishing mortality is to be kept at a sustainable level on the portion of the stock which remains vulnerable. Many models of MPAs predict distributed benefits which result in no net loss of yield in the medium or long term, and often a net gain if the stock is over-exploited. Nonetheless, until there are data to suggest such benefits are

occurring in a specific case, DFO will have to manage the portion of the stock remaining vulnerable to fishing in a sustainable manner.

A bibliography of some of the literature on MPAs was distributed at the meeting, and is included as Appendix 4 of this Report.

Appendix 1: Attendance at Adhoc PSARC Subcommittee Meeting March 10-12, 1997

Day 1:

Name	Site	Phone #	E-mail
Rice, Jake	PBS	(250) 756-7136	ricej@pbs.dfo.ca
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Appendix 1: Attendance at Adhoc PSARC Subcommittee Meeting (Cont'd)

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Ware, Dan	PBS	(250) 756-7199	wared@pbs.dfo.ca
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Mackas, Dave	IOS	(250) 363-6442	mackas@ios.bc.ca
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McCarter, Bruce	PBS	(250) 756-7198	mccarterb@pbs.dfo.ca

Appendix 2: Correspondence distributed to staff prior to the meeting clarifying the intent and approach to be taken.

Fisheries and Oceans / Pêches et Océans — **MEMORANDUM NOTE DE SERVICE**

To / A: Science Division Heads
Pacific Region
Regional Directors; Operations, PPEB, Habitat

From / De: Chair, PSARC

Security Classification - Classification de sécurité Unclassified
Our file - Notre référence
Your File - Votré référence
Date January 14, 1997

Subject / Object: AD HOC PSARC MEETING ON MARINE ENVIRONMENTAL ISSUES

At the PSARC/RMEC meetir , of 10 January, 1997, PSARC was asked to hold an *ad hoc* meeting to review and develop Regional scientific advice on two marine environmental issues: marine protected areas (MPAs) and ocean production effects on fish stocks, particularly Pacific salmon. For both topics there is substantial work being conducting in and outside DFO, and discussions are ongoing in diverse fora. The responsibility of the PSARC review in each case is to review the scientific information, develop a Regional consensus on the scientific body of knowledge, and where appropriate formulate clear advice. The goal is to ensure that Departmental staff have a clear, scientific frame of reference in which to conduct their activities, and that the Department speaks with a single voice on these issues.

The meeting is scheduled for the week of 10 March at PBS. This date ensures that the PSARC Salmon Subcommittee meeting in April will be able to work within a Regional scientific consensus on how the effects of the ocean environment should be considered in the assessment and provision of advice on Pacific salmon stocks. Likewise, meetings are planned for Spring with partners interested in establishing MPAs. The RDG and his senior staff require clear scientific advice on the biological consequences of MPAs, and the properties of MPAs which enhance or diminish the likelihood of deriving specific benefits from MPAs.

The necessary dates in March give a short time for preparation of documents for the meeting. However, much of the information which must be tabled on both topics is already in primary or secondary literature, or policy and discussion papers. For this meeting such material can be tabled with little or no revision from its existing format. As with all PSARC meetings, the majority of meeting time is to be spent in review and discussion, and not in presentation of papers. To facilitate the review and discussion I will be working with appropriate DFO staff to make the requests for advice from this meeting as explicit as possible.

Appendix 2: Correspondence ... Cont'd

Science Division Heads and other Regional Branch Directors are asked to circulate this announcement of the meeting and call for contributions widely within their organizations. Interested individuals can contact me for more information. Division Heads and Directors as asked to provide titles of expected Working Papers or their equivalants by January 24.

J. Rice

cc: PSARC Steering Committee
RMEC

MEMORANDUM NOTE DE SERVICE

Fisheries and Oceans / Pêches et Océans

To / A Science Branch Division Heads
PSARC Steering Committee
Area Managers

From / De Jake Rice, Chair
PSARC

Security Classification - Classification de sécurité **UNCLASSIFIED**
Our file - Notre référence
Your File - Votré référence
Date February 5, 1997

Subject / Object **AD HOC PSARC MEETING ON MARINE ENVIRONMENTAL ISSUES**

I have received a great deal of support for the upcoming *ad hoc* PSARC meeting to review marine environmental issues. I particularly appreciate the support and cooperation I have received from all the Science line managers. I have also received a number of questions about the meeting, primarily from prospective participants without past experience in PSARC meetings. I have prepared the attached Questions and Answers, in an attempt to clarify major points. Science Division Heads are asked to distribute the attachment to all scientific staff. Managers in other Branches are asked also to distribute the attachment widely. I stress that participation by staff in harvest and habitat management, PPEB, enhancement, and other operational fields is welcome, and necessary to ensure the advice arising from the meeting will be useful.

Despite enthusiastic comments from many staff, and assurances of attendance, I have received no titles of Working Papers or background documents to be considered at the meeting. **I require a list of Working Paper titles and authors, and background documents by February 17.** The Working Papers themselves are needed by February 28, if we are to comply with usual PSARC review processes. The meeting is considered a high priority by RMEC. Division Heads must ensure the necessary documentation is prepared in a timely manner.

Thanks to all for their support and cooperation. I look forward to an exciting and groundbreaking meeting.

Jake Rice

cc: J. Davis
K. Bruce

Attach.

AD HOC PSARC REVIEW OF MARINE ENVIRONMENTAL ISSUES

Response to the earlier memo on this meeting, scheduled for March 10-13 at PBS, has been positive. However, because the meeting will bring many new participants into the PSARC process, I have also received a number of questions about the meeting objectives and process. I will try to answer those questions, and also clarify the type of advice which is necessary from the meeting. **DIVISION HEADS ARE ASKED TO CONVEY TITLES AND AUTHORS OF WORKING PAPERS TO THE CHAIR OF PSARC BY FEBRUARY 17. COPIES OF BACKGROUND DOCUMENTS ARE DUE IN THE PSARC OFFICE BY THAT DATE AS WELL.**

OCEAN CLIMATE QUESTIONS

Why is PSARC looking at ocean climate indices?

It is now widely accepted by internal and external clients that the dynamics of fish stocks are influenced by oceanographic and atmospheric climate conditions. The Region requires a scientific consensus of which ocean and atmospheric climate indicators should be considered in developing scientific advice on the status and trajectories of fish stocks, and how they should be used.

Studies are still underway. Isn't it too soon to ask for a scientific consensus.?

Scientific uncertainty is a part of all assessment and advisory frameworks. The Department uses the best available scientific information in its assessments and management. This information often includes results from studies which are incomplete, or not definitive. The alternatives of not considering the marine environment at all in advice, or of providing advice to clients which uses marine environmental information in ways which are inconsistent or even contradictory, are far less desirable than using information from an interim consensus.

What uses will be made of the Report and advice from this meeting?

The Report of the meeting will present the Region's best scientific advice on which oceanographic factors should be considered in the assessment and forecasting of fish stocks. Assessment scientists will use the Report as a guide to which environmental covariates should be explored in evaluating the magnitude and causes of past variations in stock status, and in forecasting future trajectories of stocks. It would also be of value if the Report provided guidance on how the covariates should or should not be used. Undoubtedly the Report will also be influential in workplanning decisions. Clear statements of most promising future activities would be valuable.

What if I disagree with the Subcommittee consensus?

Consensus reports are just that: a scientific consensus, not a majority vote. If the Subcommittee cannot reach consensus, it can delineate alternative possibilities with the evidence supporting and against each alternative. It can also provide advice on the risks associated with the acceptance of each alternative. To ensure the Department is consistent in its interactions with internal and external clients, however, Subcommittee Reports are binding until new advice is available. The opinions that all Departmental spokespersons convey to all clients are the opinions in the PSARC Reports.

Doesn't the binding nature of PSARC advice stifle scientific inquiry?

No. This question fails to recognize the dual responsibilities of Science Branch to conduct research and provide advice. As researchers, free scientific inquiry and debate is encouraged, within the full scientific

community. As advisors, however, we must speak with a consistent and authoritative voice, so our internal and external clients can be confident that their actions and decisions are consistent with the best scientific advice on issues. They are not asked to disentangle diverse, incompatible expert opinions, nor given the opportunity to pick the least troublesome opinion.

I'm already publishing my work in the primary literature. Why should I waste time rewriting it for this meeting?

Participants in the meeting are encouraged to provide copies of key publications or preprints, which will be circulated in advance of the meeting. The Working Papers which are required should focus specifically on our role in advising assessment scientists and fisheries managers. They should address issues like " What aspects of advice to managers should incorporate oceanographic or meteorological factors? Which factors? Incorporate them how?" The more Working Papers focus on the advisory role of PSARC and Science Branch, the more useful they will be. Publications and Working Papers which merely provide evidence that environmental factors affect fish stocks are important background, but most address our research role rather than our advisory role.

MARINE PROTECTED AREAS QUESTIONS

Many groups with DFO participation are already looking at Marine Protected Areas. Why is PSARC getting involved?

PSARC's role in Marine Protected Areas is advisory to the RDG and other Departmental staff. There are many claims being made about the conservation benefits of MPAs. PSARC has been asked to advise on the validity of the claims, and the conditions necessary for achieving those benefits.

MPAs are a complex issue. Is PSARC the right body to deal with all those issues?

PSARC will only address the biological aspects of conservation benefits of MPAs. This is consistent with its advisory role on biological and conservation aspects of complex fisheries management issues. All

PSARC Working Papers have a footnote on the cover page stating " PSARC Working Papers document the scientific basis for fisheries management advice in the Pacific Region. As such they provide one component of the assessment process, and are not intended as comprehensive treatments of stock management issues." A comparable footnote will be required on Working Papers for this meeting.

Some specific sites have been proposed for MPAs in the Pacific Region. Why not just review those sites.

PSARC has been asked to develop a consistent scientific framework for evaluating ALL proposals for MPAs. The Region will determine the appropriate process to review specific proposals once the overall framework is clear.

What do I need to prepare for the meeting?

Prior to the meeting, the Chair will circulate all Working Papers as well as key background documentation. Suggestions for good background documents are invited. Working Papers can address specific scientific and conservation issues, standards of evaluation, Regional science concerns about MPAs, or can be scientific critiques of background documents.

Appendix 3 Expanded Framwork for PSARC - Monday March 10, 1997

PREMISE: It is assumed to be demonstrated adequately that the productivity and/or dynamics of species spending all or part of their life histories in marine environments are influenced by variation in attributes of the marine environment. From this premise it follows that:

- It may be possible to improve the accuracy and/or precision of assessments by considering variance in the marine environment.

- Management strategies may be more precautionary by considering the state and trajectory of the marine environment.

Within the context "best scientific advice" may involve explicit consideration of the ocean environment in assessments and advice. Moreover, the needs for efficiency , scientific rigor, clarity, and consistency in DFO's practices make it desirable to take a structured approach to incorporating environmental considerations in assessments and advice.

This meeting has been called to identify opportunities to improve current practice in assessment and provision of advice taking note of the points made above. It is suggested that the meeting address a few specific points.

1. Identify a modest number of environmental attributes/independent variables, which are thought to be reasonable candidates to explore using in assessments of marine and anadromous species. These attributes may be specific to particular groups of species or regions of the coast. Some properties of these attributes are obvious (readily available in a cost effective way, low uncertainty relative to things we are trying to estimate from them), but there may be other properties as well.

2. Identify the assessment parameters/features most likely to reflect the influences of the environment in ways which are analytically tractable. for example; are we best off using them to explain part of the variance in time series of catches, CPUE, or surveys? In forecasting, to modify expected levels of recruitment, size, stage, etc. Do other alternatives have promise?

3. In formulating scientific advice which is precautionary yet provides for sustainable use of resources, are there environmental considerations which should cause us to modify advice in some circumstances? What sorts of environmental considerations? What types of adjustments? What types of rationales would be necessary.

Appendix 4 Reference List of MPAs

Listing Created 14 Mar 1997, at 14:45

Agardy, M.T. 1995. Critical area identification and zoning in coastal biosphere reserves: one way to make marine conservation work in Canada. pp. 31-36. *In* N.L. Shackell and J.H.M. Willison (ed.) Marine Protected Areas and Sustainable Fisheries. Science and Management of Protected Areas Association, Wolfville.

Allard, J., M. Chadwick, and L. LaPierre. 1995. The model ocean: an experiment in marine resource management. pp. 31-36. *In* N.L. Shackell and J.H.M. Willison (ed.) Marine Protected Areas and Sustainable Fisheries. Science and Management of Protected Areas Association, Wolfville.

Anonymous. 1993. Un parc national marin en Mer d'Iroise - Éléments de réflexion et orientations. Parc Natural Régional d'Armorique.

Anonymous. 1994. Programme AMURE (AMénagement des Usages, des Ressources et des Écosystèmes marins). Ifremer, Orstrom, UBO.

Anonymous. 1997. An approach to the establishment and management of marine protected areas under the Oceans Act. A discussion Paper, Dept. Fisheries and Oceans.

Archer, J.H. 1988. The proposed Flower Garden Banks Marine Sanctuary - Protecting marine resources under international law. Oceanus 31:54-58.

Armstrong, D.A., T.C. Wainwright, G.C. Jensen, P.A. Dinnel, and H.B. Andersen. 1993. Taking refuge from bycatch issues: red king crab (*Paralithodes camtschaticus*) and trawl fisheries in the eastern Bering Sea. Can. J. Fish. Aquat. Sci. 50:1993-2000.

Auster, P.J., and R.J. Malatesta. 1995. Assessing the role of non-extractive reserves for enhancing harvested populations in temperate and boreal marine systems. pp. 31-36. *In* N.L. Shackell and J.H.M. Willison (ed.) Marine Protected Areas and Sustainable Fisheries. Science and Management of Protected Areas Association, Wolfville.

Ballantine, B. 1991. Marine Reserves for New Zealand. University of Auckland, Leigh Laboratory Bulletin No. 25: 196 p.

Ballantine, B.W. 1995. Marine reserves in New Zealand: principles and lessons. Presented to the Center for Marine Conservation workshop, Bahamas.

Ballantine, B.W. 1996. 'No-take' marine reserve networks support fisheries. Paper for 2nd World Fisheries Congress, Brisbane.

Ballantine, B.W. 1997. Design principles for systems of 'no-take' marine reserves. Paper for workshop on : The Design and Monitoring of Marine Reserves, at Fisheries Centre, University of British Columbia, Vancouver, Feb 18-20 1997.

Ballantine, W.J. 1995. Networks of "no-take" marine reserves are practical and necessary. pp. 13-20. *In* N.L. Shackell and J.H.M. Willison (ed.) Marine Protected Areas and Sustainable Fisheries. Science and Management of Protected Areas Association, Wolfville.

Barley, G. 1993. Integrated coastal management: the Florida Keys example from an activist citizen's point of view. Oceanus 36:15-18.

Bennett, B.A., and C.G. Attwood. 1991. Evidence for recovery of a surf-zone fish assemblage following the establishment of a marine reserve on the southern coast of South Africa. Mar. Ecol. Prog. Ser. 75:173-181.

Bohnsack, J.A. 1993. Marine reserves. Oceanus 36:63-71.

Bondareff, J.M. 1988. The M/V Wellwood grounding: a sanctuary case study - The legal issues. Oceanus 31:44-45.

Breen-Neddham, H., and J. Lash. 1993. Achieving true marine protected status for Gabriola Passage. Marine Life Sanctuaries Society.

Brunckhorst, D.J. 1994. Marine protected areas and biosphere reserves: 'Towards a new paradigm'. Australian Nature conservation agency, Canberra, Australia. 98p.

Brunckhorst, D.J., and P.B. Bridgewater. 1995. Marine bioregional planning: a strategic framework for identifying marine reserve networks, and planning sustainable use and management. pp. 31-36. *In* N.L. Shackell and J.H.M. Willison (ed.) Marine Protected Areas and Sustainable Fisheries. Science and Management of Protected Areas Association, Wolfville.

Burton, R.S., and S.G. Swisher. 1984. Population structure of the intertidal copepod *Tigriopus californicus* as revealed by field manipulation of allele frequencies. Oecologia 65:108-111.

Canada. 1995. The Canada Oceans Act (COA). Summary - Memo.

Carr, M.H. 1989. Effects of macroalgal assemblages on the recruitment of temperate zone reef fishes. J. Exp. Mar. Biol. Ecol. 126:59-76.

Carr, M.H., and D.C. Reed. 1993. Conceptual issues relevant to marine harvest refuges: examples from temperate reef fishes. Can. J. Fish. Aquat. Sci. 50:2019-2028.

Castilla, J.C., and R.H. Bustamante. 1989. Human exclusion from rocky intertidal of Las Cruces, central Chile: effects on *Durvillea antarctica* (Phaeophyta, Durvilleales). Mar. Ecol. Prog. Ser. 50:203-214.

Cava, F.M., J.H. Robinson, and S.A. Earle. 1993. Should the Arabian (Persian) Gulf become a marine sanctuary? Oceanus 36:53-62.

Appendix 4 Reference List of MPAs ... Cont'd

Cole, R.G., T.M. Ayling, and R.G. Creese. 1990. Effects of marine reserve protection at Goat Island, northern New Zealand. N.Z. J. Mar. Freshwater Res. 24:197-210.

Cozan, J.-Y. 1993. Compte-rendu du Conseil Scientifique de la Réserve en Mer d'Iroise. Parc Naturel Régional d'Armorique.

Cushman, S. 1993. Los Marineros: an investment in the future of our oceans - and our children. Oceanus 36:41-48.

Davis, D.S. 1995. A system approach to the identification of marine protected areas. pp. 31-36. *In* N.L. Shackell and J.H.M. Willison (ed.) Marine Protected Areas and Sustainable Fisheries. Science and Management of Protected Areas Association, Wolfville.

de Macedo, T. 1995. An overview of marine protected areas: global status, management models and benefits of establishment. Draft report, Land Use Coordination Office.

DeMartini, E.E. 1993. Modeling the potential of fishery reserves for managing Pacific coral reef fishes. Fish. Bull. 91:414-427.

Dixon, J.A. 1993. Economic benefits of marine protected areas. Oceanus 36:35-40.

Dugan, J.E., and G.E. Davis. 1993. Introduction to the International Symposium on Marine Harvest Refugia. Can. J. Fish. Aquat. Sci. 50:1991-1992.

Dugan, J.E., and G.E. Davis. 1993. Applications of marine refugia to coastal fisheries management. Can. J. Fish. Aquat. Sci. 50:2029-2042.

Durán, L.R., and J.C. Castilla. 1989. Variation and persistence of the middle rocky intertidal community of central Chile, with and without human harvesting. Marine Biology 103:555-562.

Ehler, C.N., and D.J. Basta. 1993. Integrated management of coastal areas and marine sanctuaries. Oceanus 36:6-14.

Eldredge, M. 1993. Stellwagen Bank - New Englang's first sanctuary. Oceanus 36:72-74.

Environment Canada. 1986. National Marine Parks Policy. 17 p.

Foster, N.M., and J.H. Archer. 1988. Introduction: The National Marine Sanctuary Program - Policy, Education, and Research. Oceanus 31:4-17.

Game, M. 1980. Best shape for nature reserves. Nature 287:630-632.

Gitschlag, G.R. 1986. Movement of pink shrimp in relation to the Tortugas Sanctuary. N.Amer. J. Fish. Management 6:328-338.

Appendix 4 Reference List of MPAs ... Cont'd

Gittings, S.R., and T.J. Bright. 1988. The M/V Wellwood grounding: a sanctuary case study - The Science. Oceanus 31:35-41.

Goddard, J.M. 1975. The intertidal and subtidal macroflora and macrofauna in the proposed Juan de Fuca national marine park near Victoria, B.C. Prepared for parks Canada by Dobrocky Seatech Ltd.

Graham, R., and D.W. Huff. 1983. Annotated bibliography of underwater and marine park related initiatives in northern latitudes. Marine Studies, National Parks Branch.

Graham, R.[E. 1990. Marine ecological areas in Canada - Perspectives of the Canadian Counsil on Ecological Areas Task Force on Marine Protected Areas. Occasional Paper No.9.

Gubbay, S. 1995. Marine Protected Areas - Principles and Techniques for Management. Chapman & Hall, London. 232p.

Hale, L.Z., and S.B. Olsen. 1993. Coral reef management in Thailand. Oceanus 36:27-34.

Harding, L.E., and R.C.H. Wilson. 1995. Integrated marine ecosystem monitoring: the Pacific marine ecozone trial. pp. 31-36. *In* N.L. Shackell and J.H.M. Willison (ed.) Marine Protected Areas and Sustainable Fisheries. Science and Management of Protected Areas Association, Wolfville.

Harper, J.R., G.A. Robillard, and J. Lathrop. 1983. Marine regions of Canada: framework for Canada's system of national marine parks. Prepared for Parks Canada, Hull, Quebec, by Woodward-Clyde Consultants, Victoria, B.C.

Harrigan, W.J. 1988. The M/V Wellwood grounding: a sanctuary case study - Management: coping with disaster. Oceanus 31:42-43.

Hawkes, M.W. 1994. Conserving marine ecosystems: are British Columbia's marine protected areas adequate? pp. 393-410. *In* L.E. Harding and E. McCullum (ed.) Biodiversity in British Columbia: Our Changing Environment. Canadian Wildlife Service, Environment Canada,.

Herman, T.B., s Bondrup-Nielsen, J.H.M. Willison, and N.W.P. Munro. 1995. Ecosystem Monitoring and Protected Areas. Science and Management of Protected Areas Association, Wolfville. 590p.

Hirvonen, H.E., L. Harding, and J. Landucci. 1995. A national marine ecological framework for ecosystem monitoring and state of the environment reporting. pp. 31-36. *In* N.L. Shackell and J.H.M. Willison (ed.) Marine Protected Areas and Sustainable Fisheries. Science and Management of Protected Areas Association, Wolfville.

Appendix 4 Reference List of MPAs ... Cont'd

Hoagland, P., and T.K. Eichenberg. 1988. The Channel Islands National Marine Sanctuary. Oceanus 31:66-74.

IUCN's Commission on National Parks and Protected Areas. 1984. Categories, objectives and criteria for protected areas. pp. 47-53. *In* J.A. McNeely and K.R. Miller (ed.) National Parks, Conservation, and Development - The role of Protected Areas in Sustaining Society. Smithsonian Institution Press, Washington, D.C.

Johannes, re. 1978. Traditional marine conservation methods in Oceania and their demise. Ann. Rev. Ecol. Syst. 9:349-364.

Kaza, S. 1988. Community involvement in marine protected areas. Oceanus 31:75-81.

Kelleher, G. 1986. Managing the Great Barrier Reef. Oceanus 29:13-19.

Kelleher, G., and R. Ketchington. 1992. Guidelines for establishing marine protected areas. A Marine Conservation and Development Report. IUCN, Gland, Switzerland. vii + 79 pp.

Kelsey, E., J. Nightingale, and M. Solin. 1995. The role of partnerships in implementing a new marine protected area: a case study of Whytecliff Park. pp. 31-36. *In* N.L. Shackell and J.H.M. Willison (ed.) Marine Protected Areas and Sustainable Fisheries. Science and Management of Protected Areas Association, Wolfville.

Klima, E.F., G.A. Matthews, and F.J. Patella. 1986. Synopsis of the Tortugas pink shrimp fishery, 1960-1983, and the impact of the Tortugas Sanctuary. N.Amer. J. Fish. Management 6:301-310.

Klima, E.F., and T.W. Roberts. 1986. Overview of the Tortugas Sanctuary studies. N.Amer. J. Fish. Management 6:297-300.

Krajina, V.J. 1973. The conservation of natural ecosystem in British Columbia. Syesis 6:17-31.

Lash, J. 1997. Deepen Your Understanding - Marine Protected Areas: a Guide to Establishing a Marine Protected Area in your Community. Marine Life Sanctuary Society.

Latrouite, D. 1995. Recensement des réserves à crustacé. Ifremer Brest.

Lien, J., and R.[eds] Graham. 1985. Marine parks & conservation: challenge and promise. Vol. 1, National and Provincial Parks Association of Canada. 254 p.

Malis, R.P., and W.R. Hourston. 1971. National marine parks - Straits of Georgia and Juan de Fuca. Report to the Interdepartmental Task Force on National Marine Parks submitted by the Task Force Technical Working Group.

Malis, R.P., and W.R. Hourston. 1971. National marine parks - Straits of Georgia and Juan de Fuca. Appendix A: Background papers and information. Report to the Interdepartmental Task Force on National Marine Parks submitted by the Task Force Technical Working Group.

Malis, R.P., and W.R. Hourston. 1971. National marine parks - Straits of Georgia and Juan de Fuca. Appendix B: Maps and explanatory notes. Report to the Interdepartmental Task Force on National Marine Parks submitted by the Task Force Technical Working Group.

Marine Parks Centre of Japan. 1977. Collected abstracts and papers of the international conference on marine parks and reserves. Bull. Marine Park Res. St. 1:328 p.

McClanahan, T.R., and N.A. Muthiga. 1988. Changes in Kenyan coral reef community structure and function due to exploitation. Hydrobiologia 166:269-276.

McClanahan, T.R., and S.H. Shafir. 1990. Causes and consequences of sea urchin abundance and diversity in Kenyan coral reef lagoons. Oecologia 83:362-370.

McCormick, M.I., and J.H. Choat. 1987. Estimating total abundance of a large temperate-reef fish using visual strip-transects. Marine Biology 96:469-478.

McNeely, J.A., and K.R. Miller. 1984. National Parks, Conservation, and Development - The role of Protected Areas in Sustaining Society. Smithsonian Institution Press, Washington, D.C. 825p.

Miller, E.M. 1988. A time for decision on submerged cultural resources. Oceanus 31:25-34.

Mondor, C., and B. Henwood. 1988. Proceedings of the workshop on national park planning. Hull, Quebec, February 23-25, 1988.

Neis, B. 1995. Fisher's ecological knowledge and marine protected areas. pp. 31-36. *In* N.L. Shackell and J.H.M. Willison (ed.) Marine Protected Areas and Sustainable Fisheries. Science and Management of Protected Areas Association, Wolfville.

Nichols, S. 1986. Updated yield-per-recruit information on the Tortugas pink shrimp fishery. N.Amer. J. Fish. Management 6:339-343.

Novaczek, I. 1995. Possible roles for marine protected areas in establishing sustainable fisheries in Canada. pp. 31-36. *In* N.L. Shackell and J.H.M. Willison (ed.) Marine Protected Areas and Sustainable Fisheries. Science and Management of Protected Areas Association, Wolfville.

Nowlis, J.S., and C. Roberts. in press. You can have your fish and eat it,too theoretical approaches to merine reserve design. Proceedings of the 8th International Coral Reef Symposium.

O'Neill, B. 1993. Alternative support for protected areas in an age of deficits. Oceanus 36:49-52.

Paish, H. 1970. Symposium on the proposal to name Strait of Georgia a national underwater park: Vancouver, British Columbia, October 2-4 1970. Department of Fisheries and Forestry, Vancouver, B.C.

Paisley, R.K. 1995. Science and the establishment of marine protected areas. pp. 31-36. *In* N.L. Shackell and J.H.M. Willison (ed.) Marine Protected Areas and Sustainable Fisheries. Science and Management of Protected Areas Association, Wolfville.

Palsson, W.A., and R.E. Pacunski. 1995. The response of rocky reef fishes to harvest refugia in Puget Sound. Puget Sound Research '95 Proceedings, Meydenbauer Center, Bellevue, Washington, Jan. 12-14 1995.

Pennanguer, S. 1994. Concept et gestion des zones marines dans les parcs nationaux canadiens. Étude réalisée pour le parc natural régional d'Armorique.

Polacheck, T. 1990. Year around closed areas as a management tool. Natural Resource Modeling 4:327-354.

Polunin, N.V.C., and C.M. Roberts. 1993. Greater biomass and value of target coral-reef fishes in two small Caribbean marine reserves. Mar. Ecol. Prog. Ser. 100:167-176.

Recchia, C., C. Saint-Laurent, and A. Hackman. 1995. World Wildlife Fund's endangered spaces campaign: focus on marine protected areas. pp. 31-36. *In* N.L. Shackell and J.H.M. Willison (ed.) Marine Protected Areas and Sustainable Fisheries. Science and Management of Protected Areas Association, Wolfville.

Richards, D.V., and G.E. Davis. 1993. Early warning of modern population collapse in black abalone *Haliotis cracherodii*, Leach, 1814 at the California Channel Islands. J. Shellfish Res. 12:189-194.

Roberts, C.M. 1997. Ecological advice for the global fisheries crisis. TREE 12:35-38.

Roberts, C.M., and N.V.C. Polunin. 1991. Are marine reserves effective in management of reef fisheries? Rev. Fish Biol. Fish. 1:65-91.

Roberts, T.W. 1986. Abundance and distribution of pink shrimp in and around the Tortugas Sanctuary, 1981-1983. N.Amer. J. Fish. Management 6:311-327.

Robinson, B.H. 1993. New technologies for sanctuary research. Oceanus 36:75-80.

Rogers-Bennett, L., W.A. Bennett, H.C. Fastenau, and C.M. Dewees. 1995. Spatial variation in red sea urchin reproduction and morphology: implications for harvest refugia. Ecological Applications 5:1171-1180.

Appendix 4 Reference List of MPAs ... Cont'd

Rowley, R.J. 1992. Impacts of marine reserves on fisheries - A report and review of literature. Science & Research Series No. 51, New Zealand Dept. of Conservation.

Rowley, R.J. 1994. Case studies and reviews - Marine reserves in fisheries management. Aquatic Conservation: Marine and Freshwater Ecosystems 4:233-254.

Russ, G.R., and A.C. Alcala. 1989. Effects of intense fishing pressure on an assemblage of coral reef fishes. Mar. Ecol. Prog. Ser. 56:13-27.

Shackell, N.L., and J.H.M. Willison. 1995. Marine Protected Areas and Sustainable Fisheries. Science and Management of Protected Areas Association, Wolfville. 300p.

Shepherd, S.A., and L.D. Brown. 1993. What is an abalone stock: implications for the role of refugia in conservation. Can. J. Fish. Aquat. Sci. 50:2001-2009.

Shinn, E.A. 1988. The geology of the Florida Keys. Oceanus 31:46-53.

Simberloff, D., and L.G. Abele. 1982. Refuge design and island biogeographic theory: Effects of fragmentation. The American Naturalist 120:41-50.

Sobel, J. 1993. Conserving biological diversity through marine protected areas: a global challenge. Oceanus 36:19-26.

Stamps, J.A., M. Buechner, and V.V. Krishnan. 1987. The effects of edge permeability and habitat geometry on emigration from patches of habitat. The American Naturalist 129:533-552.

Tegner, M.J. 1993. Southern California abalones: can stocks be rebuilt using marine harvest refugia? Can. J. Fish. Aquat. Sci. 50:2010-2018.

Thomas, W.J. 1988. Fagatele Bay: a sanctuary in Samoa. Oceanus 31:18-24.

Thurston, H. 1997. A wilderness of sea - Safeguarding Canada's Oceans and Great Lakes with protected areas. World Wide Fund Canada.

Weber, M.L. 1988. Should the Koholà be given *Pu'uhonua*? Oceanus 31:59-65.

World Wide Fund Canada. 1995. British Columbia and the endangered spaces campaing. Endangered Spaces Campaing 95-96.

World Wide Fund Canada. 1995. Marine protected areas and the endangered spaces campaing. Endangered Spaces Campaing 95-96.

World Wide Fund Canada. 1995. Can we afford NOT to protect wild places? Endangered Spaces Campaing 95-96.

World Wide Fund Canada. 1996. Endangered Spaces Progress Report 95-96. Endangered Spaces Campaign, No. 6: 65 p.

Yurick, D.B. 1988. International networking of marine sanctuaries. Oceanus 31:82-87.

Zacharias, M.A., and D.E. Howes. 1997. An analysis of marine protected areas in British Columbia using a marine ecological classification. Natural Areas Journal.

Pacific Stock Assessment Review Committee

An Inventory of Environmental Data for Stock Assessment

Robin Brown
Howard Freeland

Ocean Science and Productivity Division
Institute of Ocean Sciences
P.O. Box 6000, Sidney, B.C. V8L 4B2

02-Apr-97

OWS Papa - Chlorophyll and primary production

Data Category: BIO **ID:** 7

Parameter: Chlorophyll, primary productivity

Frequency: variable

Measurement Details: primary production and chlorophyll a measurements from 1969-1976 and 1984-1990

Geographic Area: Ocean Station PAPA;

Start of Observations: 1954

End of Observations: ONGOING

Custodian: C.S. Wong, Institute of Ocean Sciences, P.O. Box 6000, Sidney, B.C

Publication: Wong, C.S., F.A. Whitney, K. Iseki, J.S. Page, and J. Zeng. 1995. Analysis of trends in primary production and Chlorophyll-a over two decades at Ocean Station P in the subarctic Northeast Pacific Ocean, p.107-117. in Beamish, R.J. [ed.]. 1995. Climate change and northern fish populations. Can Spec. Publ. Fish. Aquat. Sci. 121:739 p.

Data Distribution: contact custodian (email: cswong@ios.bc.ca). These data will soon be available in the IOS/OSAP water property profile database,

Utility for Stock Assessment: These data have been gathered on an intermittent basis over the lifetime of the Station P program. Part of the "regime shift" hypothesis is a suggestion that the productivity of the Northeast Pacific may change significantly over time. These data contain measurements of primary production (standing stock and rates of production). There are issues about the comparison of older methodologies with current techniques. These concerns are addressed the above publication.

Potential Improvements: The data could be summarized or aggregated by month or year as per the figures in the above publication.

Internet/URL: http://www.ios.bc.ca

Contributor: Robin Brown

OWS Papa - zooplankton biomass and composition

Data Category: BIO **ID:** 9

Parameter: Zooplankton

Frequency: variable

Measurement Details: total zooplankton biomass (wet weight) and composition for major taxa (numbers/cubic metre)

Geographic Area: Ocean Station PAPA (50 deg N; 145 deg W)

Start of Observations: 1956

End of Observations: 1980

Custodian: PICES Secretariat or Institute of Ocean Sciences

Publication: Waddell, Brenda J., and Skip McKinnell. 1995. Ocean Station "Papa" detailed zooplankton data: 1956 - 1980. Can. Tech. Rep. Fish Aquat. Sci. 2056: 21p; see also Brodeur, R.D. and D.M. Ware. 1992. Long -term variability in zooplankton biomass in the subarctic Pacific Ocean. Fish. Oceanogr.1:32-38

Data Distribution: Diskette containing data files and report is available from the PICES Secretariat. Hard copy report available from PICES Secretariat or DFO (Pacific Biological Station). Available on-line on the IOS SHARE_DATA disk - directory \STNP\ZOOPLANK

Utility for Stock Assessment: These data contain information about secondary production at Station P. Detailed discussion on issues of sampling and processing are included in the report. Some additional samples have are available since 1980 (project SUPER, Canadian JGOFS program and others -see Dr. David Mackas, Institute of Ocean Sciences) but there will likely be difficulties comparing the daatsets due to differences in sampling design.

Potential Improvements: The dataset could be improved by adding data from other sources (SUPER and Canadian JGOFS programs) and resolving "intercalibration" or conversion factor problems between the different sampling techniques (Skip McKinnell and Dave Mackas are working on this issue).

Internet/URL: http://pices.ios.bc.ca

Contributor: Robin Brown/Skip McKinnell

HOTS- Hawaii Ocean Time Series

Data Category: BIO **ID:** 62

Parameter: temperature, salinity, oxygen, nutrients, primary production, sediment

Frequency: Monthly

Measurement Details: Scientists working within the Hawaiian Ocean Time-series (HOTS) project have been making repeated observations of the hydrography, chemistry and biology at a station north of Hawaii since October 1988. The objective of this research is to provide a comprehensive description of the ocean at a site representative of the central North Pacific Ocean. Cruises are made approximately once a month to Station ALOHA, the HOT deep-water station (22 45'N, 158W) located about 100 km north of Oahu, Hawaii.
Measurements of the thermohaline structure, water column chemistry, currents, primary production and particle sedimentation rates are made over a 72-hour period on each cruise.

Geographic Area: subtropical/tropical North Pacific

Start of Observations: 1988

End of Observations: ongoing

Custodian: University of Hawaii, Department of Oceanography

Publication:

Data Distribution: contact custodian

Utility for Stock Assessment: This time series is still quite young. Althought it is located outside of the range of species that are significant to DFO Pacific Region, it may still provide indications of "regime shifts" or structural changes in the North Pacific ecosystem. Direct relevence to stock assessement in Pacific Region has not yet been demonstrated.

Potential Improvements: none appropriate at this time

Internet/URL: http://hahana.soest.hawaii.edu/hot/hot.html

Contributor: Robin Brown

FNMOC SLP, winds and upwelling indices

Data Category: MET **ID:** 30

Parameter: Sea level pressure, north and east components of wind velocity, north

Frequency: 6 hour/daily/monthly

Measurement Details: Source data are US Navy Fleet Numerical Meteorology and Oceanography (FNMOC) synoptic surface pressure analyses. Primary products are derived from the FNMOC 63x63 northern hemisphere polar stereographic surface atmospheric pressure field available at six-hour intervals.

Geographic Area: 18-63N, 130E-101W from 3-degree pressure, wind-driven ocean flow

Start of Observations: 1946

End of Observations: ongoing

Custodian: Roy Mendelssohn, Pacific Fisheries Environmental Group, National M

Publication: Bakun, A. 1990. Global climate change and intensification or coastal ocean upwelling. Science (Wash.,D.C.) 247:198-201

Data Distribution: Historical upwelling data available at IOS - SHARE_DATA disk; \UPWELL directory. PFEG now has these data on-line and available for direct downloading (http://www.pfeg.noaa.gov)

Utility for Stock Assessment: Upwelling indices have been used in comparisons with fish catch, ocean survival and growth.

Potential Improvements: Automate the update process and provide additional file options (IOS Header and or CSV spreadsheet format). Create public directory for these or add them to our INTERNET WWW server site.

Internet/URL: http://upwell.pfeg.noaa.gov/

Contributor: Bill Karp/Roy Mendelssohn

Offshore meteorological.oceanographic buoys (Canada)

Data Category: MET **ID:** 3

Parameter: Air Pressure, Air Temperature, Wind Speed and Direction

Frequency: hourly

Measurement Details: 16 offshore, coastal and inshore moored buoys with on-board data loggers and telemetry via GOES. Various starting dates (earliest is 1988).

Geographic Area: Canadian Pacific Coast and offshore waters (48 - 54 deg N 122 - 140

Start of Observations: 1988

End of Observations: ongoing

Custodian: Robin Brown, Oceanographic Data Manager, Institute of Ocean Scien

Publication: Technical details on data processing, calibration etc. are available in "Meteorological and Oceanographic Measurements from Canadian Weather Buoys - a Review of Senors, Data Reduction, Transmission, Quality Control and Archival Methods", 1996. Pepared by Axys Environmental Consulting Ltd. for Environment Canada. Copy in IOS Library Technical Records.

Data Distribution: Historical have been assembled from varous sources (MEDS and PWC) and are available at IOS. [Share_data disk: \METBUOY]. Real-time data are received at IOS and eventually "replaced" by data from AES that has been through their QC/QA procedures.

Utility for Stock Assessment: The meteorological data from these buoys is probably of limited (direct) use in stock assessment, due to the short time series. One possible use might be in determining the timing of the spring and fall transitions in the current flow off Vancouver Island.

Potential Improvements: Data are archived at their original sampling interval (hourly). They have been subjected to AES quality control, but there are gaps in the data due to sensor or system failures. We have not assembled daily or monthly summaries of these data. Real time data (unverified by AES) are available at IOS. Some additional work is required to merge data formats (particularly "time" coding). Processes could be developed to automatically generate daily and monthly summary files, which are likely to be more relevent for stock assessment use. In addition, we could attempt to reconstruct the time series BACK in time by extracting data at these locations from the COADS dataset.

Internet/URL: http://www.ios.bc.ca

Contributor: Robin Brown

Global air temp anomalies

Data Category: MET **ID:** 10

Parameter: Air Temperatures

Frequency: annual

Measurement Details: Global and Hemispheric temperature anomalies; land and marine instrumental records

Geographic Area: GLOBAL

Start of Observations: 1854

End of Observations: ongoing

Custodian: Philip Jones, University of East Anglia (P.Jones@uea.ac.uk)

Publication: Jones, P.D., T.M.L. Wigley, and K.R. Briffa. 1994. Global and hemispheric temperature anomalies- land amd marine instrumental records. pp.603-608. In Boden, T.A., D.P. Kaiser, R.J. Sepanski, and F.W, Stoss (eds.). 1994. Trends'93: A Compendium of Data on Global Change. ORNL/CDIAC-65. Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory, Oak Ridge, Tennessee.

Data Distribution: This is a research dataset computed for the use of the custodian, however, he is generous and allows distribution. We recommend that potential users ask his permission to use these data and be sure to acknowledge him in any publications. Howard Freeland mainatains a continuing file of the data and the monthly series are available in the "lighthouse archive" (CCS$PHYSICS:[LIGHTHOUSE.ARCHIVE.MONTHLY]) - FILES : N_HEM.TAS (Land Air Temperature anomalies) and N_HEM_LM.TAS (Land and Marine Air temperature anomalies)

Utility for Stock Assessment: There are two types of time series for each of the N. and S. hemisphere. These represent land+marine air temperature averages (one value/month/hemisphere) and land only observations. This is the standard dataset for monitoring the effects of global warming.

Potential Improvements: We could make this available on the IOS WWW site, similar the lighthouse time series files. Some alternative formats (IOS HEADER, CSV/spreadsheet format) would be useful.

Internet/URL: http://cdiac.esd.ornl.gov/cdiac/

Contributor: Robin Brown

Canada-Regional air temperature anomalies 1895 - present

Data Category: MET **ID:** 11

Parameter: Air temperature

Frequency: annual average

Measurement Details: (Canadian) regional breakdowns of air temperatures (departures from long term means)

Geographic Area: Pacific Coast

Start of Observations: 1895

End of Observations: ongoing

Custodian: Environment Canada, Atmospheric Environment Service, Climate Re

Publication: Findlay, B.F. , D.W. Gullett, L. Malone, J. Reycraft, W.R. Skinner , L. Vincent, and R. Whitehouse. 1994. Canadian national and regional annual air temperature departures.pp. 738-764. In Boden, T.A., D.P. Kaiser, R.J. Sepanski, and F.W, Stoss (eds.). 1994. Trends'93: A Compendium of Data on Global Change. ORNL/CDIAC-65. Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory, Oak Ridge, Tennessee.

Data Distribution: In CDIAC-Trends '93 volume (plots and table). I am presently trying to get ahold of the authors to determine how we might get access to updated versions of these files.

Utility for Stock Assessment: These are "over land" air temperatures - BC regions are: South BC. Mountains and Pacific Coast. These regional annual statistics may be useful in describing long term trends, although the data are aggregated along a large north-south area.

Potential Improvements: If useful, these data could be provide on-line and updated annually

Internet/URL: http://cdiac.esd.ornl.gov/cdiac/

Contributor: Robin Brown

global and hemispheric air temperature anomalies

Data Category: MET **ID:** 14

Parameter: Air Temperatures

Frequency: annual

Measurement Details: global and hemispheric air temperature anomalies. Gridded values. Anomalies are relative to a 1951-1980 reference period.

Geographic Area: Global; hemispheric

Start of Observations: 1880

End of Observations: 1993

Custodian: CDIAC

Publication: Wilson, H and J. Hansen. 1994. Global and hemispheric anomalies from instrumental surface air temperature records. pp. 609-614. In Boden, T.A., D.P. Kaiser, R.J. Sepanski, and F.W, Stoss (eds.). 1994. Trends'93: A Compendium of Data on Global Change. ORNL/CDIAC-65. Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory, Oak Ridge, Tennessee.

Data Distribution:

Utility for Stock Assessment: Global and hemispheric temperature trends are probably of academic interest only - regional summaries are probably more relevent to stock assessment.

Potential Improvements:

Internet/URL: http://cdiac.esd.ornl.gov/cdiac/

Contributor: Robin Brown

COADS SST and surface met. data - NODC CDROM-56/57

Data Category: MET **ID:** 23

Parameter: SST, wind speed and direction, air temperature, humidity, clouds

Frequency: monthly averages

Measurement Details: processed from COADS (Comprehensive Ocean Atmosphere Data Set Release 1. Analysed on 1 deg x 1 deg grid.

Geographic Area: global

Start of Observations: 1854

End of Observations: 1989

Custodian: NODC - National Oceanographic Data Center

Publication: 1) NOAA Atlas NESDIS 6. Atlas of Surface Marine Data 1994. Volume 1: Algorithms and Procedures
2) Comprehensive Ocean Data Extraction - User's Guide. NOAA Technical Memorandum NOAA-TM-NMFS-SWFSC-228 , April 1996 by Roy Mendelssohn and Claude Roy.

Data Distribution: Available on CD-ROM at IOS from various sources: 1)NODC CD-ROMs 56 and 57. 2) COADS on CD-ROM - Vol. 4 and 5 - Western and Eastern Pacific. These versions are produced by the PFEG in Monterey, CA . This re-structured version of the COADS dataset is supplied with some data extraction software (Macintosh only). This package is designed to provide simple access to subsets of the COADS data . There are on-line, interactive graphical programs at http://ferret.wrc.noaa.gov/fbin/climate_server. Data are also distributed by Climate Diagnostics Center , who are the developers/generators of COADS (http://www.cdc.noaa.gov/~coads/)extraction software.

Utility for Stock Assessment: Includes directly measured parameters and derived parameters (by year/by month) as well as climatological means. Many investigators have used COADS to generate long time series of meteorological and oceanographic data to compare fisheries time series. There are some well-known deficiencies in the COADS data - the distribution of samples is highly variable and there are variations in the precision and accuracy of the measurements as techniques changed during the measurement time period. Users need to approach COADS data extracts with caution. There is an additional problem in gaining access to more recent COADS data (since 1989), as these data are NOT include on the CD-ROMs and it is not clear when updates will be issued.

Potential Improvements: The data extraction software provided by PFEG (available at IOS) needs to be implemented and tested.

Internet/URL: http://www.nodc.noaa.gov

Contributor: Robin Brown

NOAA Climate Prediction Center-Teleconnection Indices

Data Category: MET **ID:** 24

Parameter: Meteorological Teleconnection Indices

Frequency: monthly

Measurement Details: Standardized Northern Hemisphere Teleconnection Indices including : North Atlantic Oscilllation (NAO); East Atlantic Pattern; East Atlantic Jet Pattern; West Pacific Pattern;East Pacific Pattern; North Pacific Pattern; Pacific/North American Pattern (PNA) ; East Atlantic/West Russia Pattern; Scandinavia Pattern ; Tropical/Northern Hemisphere pattern; Polar/Eurasian Pattern; Pacific Transition Pattern; Subtropical Zonal Pattern; Asia Summer Pattern

Geographic Area: global

Start of Observations: 1950

End of Observations: ongoing

Custodian: NOAA Climate Prediction Center

Publication:

Data Distribution: via INTERNET /ftp from NOAA Climate Prediction Centre and at IOS (CCS$PHYSICS:[LIGHTHOUSE.ARCHIVE.MONTHLY]. Available indices are: EA.IAS (East Atlantic Pattern); EA_JET.IAS (East Atlantic Jet Pattern); EA_WR.IAS (East Atlantic/Western Russia Pattern); EP.IAS (East Pacific Pattern);EUR.IAS; (Eurasian Pattern); NAO.IAS; (North American Oscillation Pattern); NP.IAS (North Pacific Pattern); PNA.IAS (Pacific North America Pattern); SCAN.IAS (Scandinavian Pattern); S_OSC.IAS (Southern Oscillation Index); WA.IAS (Western North Atlantic Index); WP.IAS (Western Pacific Pattern). IOS on-line versions are presently prepared and maintained by Howard Freeland.

Utility for Stock Assessment: Several of these indices have been used in correlation-type studies of production/growth/survival of oceanic fish stocks. The Southern Oscillation Index is frequently used to detect El Nino conditions and to describe the magnitude of the El Nino event.

Potential Improvements: Automate the update process and provide additional file options (IOS Header and or CSV spreadsheet format). Create public directory for these or add them to our INTERNET WWW server site.

Internet/URL: http://nic.fb4.noaa.gov/

Contributor: Robin Brown/Howard Freeland

NOAA Marine Environmental Buoy Database

Data Category: MET **ID:** 55

Parameter: wind speed and direction, barometric pressure, air temp, SST, wave

Frequency: hourly;every 3 hours

Measurement Details: wind speed and direction, barometric pressure, air temp, SST, wave height and direction- includes bouyts and automated land-based stations (C-MAN). Some buoys report directional wave spectra starting in the late 1980's

Geographic Area: Atlantic, Equatorial Pacific, North Pacific, western Pacific

Start of Observations: various (1970's)

End of Observations: ongoing

Custodian: NODC - National Oceanographic Data Center

Publication:

Data Distribution: via CD-ROM (14 CD-ROMs plus 8 update disks) with updates available by internet. Data from Pacific Coast buoys are also available from PFEG (http://www.pfeg.noaa.gov) as monthly and daily averages. These are updated twice a year. Real-time data (and near real-time data) are available at http://www.ndbc.noaa.gov

Utility for Stock Assessment: The meteorological data from these buoys is probably of limited (direct) use in stock assessment, due to the short time series. Data from US buoys might help in monitoring conditions both north and south of B.C. coastal waters

Potential Improvements: Automate the update process and provide additional file options (IOS Header and or CSV spreadsheet format). Create public directory for these or add them to our INTERNET WWW server site.

Internet/URL: http://www.nodc.noaa.gov

Contributor: Robin Brown

River flow from Canadian Rivers - HYDAT

Data Category: MET **ID:** 94

Parameter: River Flow/Discharge

Frequency: monthly (and daily)

Measurement Details: monthly and daily stream/river flow

Geographic Area: Canada

Start of Observations: various

End of Observations: ongoing

Custodian: Environment Canada

Publication: HYDAT CD-ROM

Data Distribution: Monthly river flow data files for the Columbia, Fraser, Skeena and Kenai are available at IOS on the SHARE_DATA disk - \RIVERFLO directory, along with a document that describes the sources of the data. Historical data from the Fraser River (up to 1990) was obtained from http://lib.stat.cmu.edu/datasets/fraser-river, with recent data added from the USGS website http://water.usgs.gov/nwc/contents.html. Further details in the RIVERFLO.DOc in the \RIVERFLO directory

Utility for Stock Assessment: River flow data is key to much work in stock assessment esp. for salmon.

Potential Improvements: Assemble and maintain a single set of river flow data and make this available in selected formats. This may require some negotiation with Environment Canada.

Internet/URL:

Contributor: Robin Brown

River flow from U.S. Rivers

Data Category: MET **ID:** 95

Parameter: River Flow/Discharge

Frequency: monthly

Measurement Details: monthly and daily stream/river flow

Geographic Area: U.S.A.

Start of Observations: various (Columbia River data

End of Observations: ongoing

Custodian: United States Geological Service

Publication:

Data Distribution: Monthly river flow data files for the Columbia, Fraser, Skeena and Kenai are available at IOS on the SHARE_DATA disk - \RIVERFLO directory, along with a document that describes the sources of the data. Historical data from the Fraser River (up to 1990) were obtained from http://lib.stat.cmu.edu/datasets/fraser-river, with recent data added from the USGS website http://water.usgs.gov/nwc/contents.html. Historical data from US from USGS website at http://h2o.usgs.swr . Further details in the RIVERFLO.DOC in the \RIVERFLO directory

Utility for Stock Assessment: River flow data is key to much work in stock assessment esp. for salmon. River flow/discharge is also an important control over conditions in the Northeast Pacific, where there is very strong influence of fresh water.

Potential Improvements: Assemble and maintain a single set of river flow data from selected U. S. rivers and make this available in selected formats.

Internet/URL: http://h2o.usgs.gov

Contributor: Robin Brown

NCAR Climate Indices - NAO Index, NP Index, SOI Index

Data Category: MET **ID:** 92

Parameter: barometric pressure

Frequency: monthly

Measurement Details: details vary, but these are basically derived from monthly measurements of air pressure

Geographic Area: varies with the index

Start of Observations: 1900

End of Observations: ongoing

Custodian: National Center for Atmospheric Research

Publication: North Atlantic Oscillation (NAO):
Hurrell(1995): Science 269:676-679
North Pacific (NP) Index:
Trenberth and Hurrell (1994): Climate Dynamics 9:303-319
Southern Oscillation Index (SOI):
Trenberth (1984):Monthly Weather Review 112:326-332

Data Distribution: available at UCAR/NCAR Web site, also available at IOS - (CCS$PHYSICS:[LIGHTHOUSE.ARCHIVE.MONTHLY]. Available indices are: NAO.IAS; (North American Oscillation Pattern); NP.IAS (North Pacific Pattern); PNA.IAS (Pacific North America Pattern); S_OSC.IAS (Southern Oscillation Index). SOI index is also available on the IOS WWW server. IOS on-line versions are presently prepared and maintained by Howard Freeland.

Utility for Stock Assessment: Several of these indices have been used in correlation-type studies of production/growth/survival of oceanic fish stocks. The Southern Oscillation Index is frequently used to detect El Nino conditions and to describe the magnitude of the El Nino event.

Potential Improvements: Automate the update process and provide additional file options (IOS Header and or CSV spreadsheet format). Create public directory for these or add them to our INTERNET WWW server site.

Internet/URL: http://www.cgd.ucar.edu/cas/climind

Contributor: Kevin Trenberth/Robin Brown

Canada-MEDS /IOS Sea Level Height database

Data Category: PCO **ID:** 60

Parameter: sea level heights

Frequency: variable

Measurement Details: measurement of sea level (and lake level) heights from various stations in Canada

Geographic Area: Canada; Northeast Pacific

Start of Observations: 1900 (about)

End of Observations: ongoing

Custodian: Marine Environmental Data Service; Department of Fisheries and Oc

Publication:

Data Distribution: Data for BC coastal stations (monthly averages) are available at IOS. (CCS$PHYSICS:[LIGHTHOUSE.ARCHIVE.MONTHLY]). Howard Freeland maintains time series from three stations (BAMFIELD, TOFINO and PRINCE RUPERT). These data need careful appraisal due to tectonic effects and instrumentation problems.

Utility for Stock Assessment: variations in sea level height have been used as evidence of El Nino conditions and other oceanographic anomalies.

Potential Improvements: Generally in good shape. Some additional file format options might be useful (IOS HEADER format, spreadsheet/CSV format).

Internet/URL: http://www.meds.dfo.ca

Contributor: Robin Brown

Lighthouse SST and SSS - (Canada-West Coast)

Data Category: PCO **ID:** 1

Parameter: Sea Surface Temperature, Sea Surface Salinity

Frequency: daily

Measurement Details: bucket samples for temperature (thermometer) and salinity (hydrometer) from manned and unmanned British Columbia Coastal Lighthouse Stations. Individual daily measurements have relatively low accuracy and resolution (esp. salinity). Monthly averages are usually used. Some manned stations are being discontinued and observations are being automated. Near real time data available from Amphitrite Point (see plot of current conditions and anomalies on the IOS web site. Other stations may become available in real-time as lighthouse automation continues.

Geographic Area: Canada Pacific Coast (inshore and exposed coast) 48 - 55 deg N 122

Start of Observations: various, as early as 1914

End of Observations: ongoing

Custodian: Ron Perkin, Institute of Ocean Sciences, P.O. Box 6000, Sidney, B.C.

Publication:

Data Distribution: Monthly averages are available on the IOS Web Site (follow links thru Divisions at IOS; Ocean Science and Productivity; State of the Oceans section;Products). DAILY data are in CCS$PHYSICS:[LIGHTHOUSE.ARCHIVE]. MONTHLY data are in CCS$PHYSICS:[LIGHTHOUSE.ARCHIVE.MONTHLY]

Utility for Stock Assessment: The "lighthouse" dataset has been used in many correlation-type studies to demonstrate the influence of coastal conditions on fish stocks. Data from Quatsino Sound (Kains Island) is used in the prediction of northern diversion for returning salmon.

Potential Improvements: Generally in good shape. Some additional file format options might be useful (IOS HEADER format, spreadsheet/CSV format). Jon Schnute has constructed a database in MS-ACCESS to demonstrate the utility of such database tools.

Internet/URL: http://www.ios.bc.ca/ios/sos/bcsop/

Contributor: Robin Brown

Canada- MEDS world archive for drifting buoy data (DRIBU)

Data Category: PCO **ID:** 61

Parameter: surface currents from drifting buoys, SST, air pressure

Frequency: variable

Measurement Details: buoy positions and data via Service ARGOS (satellite tracking)

Geographic Area: global

Start of Observations: 1978

End of Observations: ongoing

Custodian: Marine Environmental Data Service; Department of Fisheries and Oc

Publication:

Data Distribution: contact Rick Thomson (rick@ios.bc.ca)

Utility for Stock Assessment: Probably of little direct use in stock assessment. Drifter data may be useful in validating circulation models and in detecting/demonstrating anomalies in the circulation of the North Pacific.

Potential Improvements: Improve access to these data. Investigate status of software "tools" to extract subsets and summaries.

Internet/URL: http://www.meds.dfo.ca

Contributor: Robin Brown

Satellite SST images - Gulf of Alaska, Bering Sea, Chukchi Sea

Data Category: PCO **ID:** 91

Parameter: SST from AVHRR

Frequency: ~4 per day

Measurement Details: MCSST sea surface temperature fields processed from HRPT data using TeraScan system.

Geographic Area:

Start of Observations: fall 1993

End of Observations: ongoing

Custodian: David L. Eslinger, Institute of Marine Sciences, University of Alaska,

Publication: contact custodian

Data Distribution: contact custodian

Utility for Stock Assessment: browse images available online at listed URL

Potential Improvements:

Internet/URL: http://murre.ims.alaska.edu:8000/

Contributor: Tom Royer

SST and salinities from U.S. Shore Stations (Pacific Coast)

Data Category: PCO **ID:** 97

Parameter: Sea Surface Temperature and salinity

Frequency: daily

Measurement Details: measurement details are provided at the web site. Daily and monthly means are available, along with plots (measurements and anomalies)

Geographic Area: Southern California to Neah Bay (Juan de Fuca Strait)

Start of Observations: 1916 (earliest station)

End of Observations: ongoing

Custodian: Scripps Institute of Oceanography - Marine Life Research group

Publication:

Data Distribution: These data are available on-line at http://www-mlrg.ucsd.edu/shoresta.html. There is a link to this web site on the IOS/OSAP "lighthouse" web page.

Utility for Stock Assessment: These data can be used to extend the B.C. "lighthouse" data over a wider area

Potential Improvements: no improvements required.

Internet/URL: http://www-mlrg.ucsd.edu/shoresta.html

Contributor: Robin Brown

NODC Ocean Current Drifter Data

Data Category: PCO **ID:** 56

Parameter: surface and subsurface currents

Frequency: variable

Measurement Details: surface currents (almost all from ship drift, plus some GEK data)- includes summaries by area by month; subsurface data (1972-1992) are from SOFAR, RAFOS and ALACE neutrally buoyant floats and are mostly from the North Atlantic.

Geographic Area: global

Start of Observations: 1900 (?)

End of Observations: 1992

Custodian: NODC - National Oceanographic Data Center

Publication:

Data Distribution: via CD-ROM - contact custodian

Utility for Stock Assessment: Limited potential use "as is". Potentially, data could be summarized in sub-regions and compared with recent measurements to detect anomalies in open ocean circulation patterns. These data could also be used to validate circulation models

Potential Improvements: nothing appropriate at this time

Internet/URL: http://nodc.noaa.gov

Contributor: Robin Brown

Canada - MEDS/IOS oceanographic data profiles

Data Category: PCO **ID:** 59

Parameter: profiles of temperature, salinity, oxygen and nutrients

Frequency: variable

Measurement Details: Physical oceanographic profiles
Over one million profiles dating back before 1900
Updated weekly: 80,000 new profiles per year.
Global coverage, but primarily in north western hemisphere
XBT, BT, CTD, Bottle, Bathy/Tesac. Inventory from XBT, BT, CTD and Bottle Archives for 1975 - 1979 (165K)
Inventory from XBT, BT, CTD and Bottle Archives for 1980 - 1984 (149K)
Inventory from XBT, BT, CTD and Bottle Archives for 1985 - 1989 (149K)
Inventory from XBT, BT, CTD and Bottle Archives for 1990 - 1995 (116K)

Geographic Area: global, but primary focus is North Atlantic, North Pacific and Arctic oc

Start of Observations: 1900

End of Observations: ongoing

Custodian: Robin Brown, Oceanographic Data Manager, Institute of Ocean Scien

Publication:

Data Distribution: Most high quality, high resolution data for coastal B.C. waters exist at IOS annd MEDS. Recent data may not be available from MEDS. Data are stored on-line in the DATA_LIBRARY (DATA_LIB). Search tools are available to select specific subsets of these data, matching user-specified search criteria.

Utility for Stock Assessment: Probably of little direct use in stock assessment. There are significant issues of data quality and distribution that make automated "aggregation" of the data tricky. Potentially, these data could be used to create water column climatologies (and anomalies) for user-specified areas/regions.

Potential Improvements: Improved software tools for "slicing, dicing" and aggregation of these data would be useful.

Internet/URL: http://www.meds.dfo.ca

Contributor: Robin Brown

Temperature and Salinity profiles - Gulf of Alaska (GAK 1)

Data Category: PCO **ID:** 44

Parameter: Temperature and salinity profiles

Frequency: monthly

Measurement Details: Sea Bird CTD measurements with calibration samples through the entire water column (263 metres). Accuracy better than +/- 0.02 deg C; +/- 0.02 psu

Geographic Area: Gulf of Alaska; (GAK 1 - 59 50.7N 149 28.0 W) (RES 2.5 - 60 01.5N;

Start of Observations: Dec 1970

End of Observations: ongoing

Custodian: Thomas C. Royer, IMS, Univ. of Alaska, Fairbanks AK 99775. ph: (9

Publication: see readme file at http://www.ims.alaska.edu:8000/gak1

Data Distribution: Data are available at http://www.ims.alaska.edu:8000/gak1. Generally, new data are posted within 30 days of collection.

Utility for Stock Assessment: Monitoring of water properties of the Alaska Stream and comparison with conditions elsewhere in the NE Pacific

Potential Improvements: No action required at this time. It is up to the oceanographers to demonstrate how these data might be useful in stock assessment.

Internet/URL: http://www.ims.alaska.edu:8000/gak1

Contributor: Tom Royer

OWS Papa - Nutrient profiles

Data Category: PCO **ID:** 6

Parameter: Nutrients

Frequency: variable

Measurement Details: profiles of nitrate, phosphate and silicate concentrations

Geographic Area: Ocean Station PAPA (50 deg N;145 deg W)

Start of Observations: 1954

End of Observations: ongoing.

Custodian: C.S. Wong, Institute of Ocean Sciences, P.O. Box 6000, Sidney, B.C

Publication:

Data Distribution: Contact custodian or Robin Brown, Oceanographic Data Manager (email: rmbrown@ios.bc.ca). These data will soon be added to the IOS/OSAP standard data archive.

Utility for Stock Assessment: Variation in surface nutrient concentration may control overall primary productivity in the North Pacific. Control of primary and secondary procuction in the North Pacific is a issue of ongoing controversy. Changes in nutrients concentrations are likely due to changes in circulation, mixing and fresh water input to the North Pacific.

Potential Improvements: Develop summary time series with suitable aggregation of data.

Internet/URL:

Contributor: Robin Brown

OWS Papa - Temp, Salinity and Oxygen profiles (WOCE PR6)

Data Category: PCO **ID:** 5

Parameter: Temperature and Salinity profiles

Frequency: variable

Measurement Details: profiles (bottle casts and CTD) from Ocean Weather Station P 1956-1996

Geographic Area: Ocean Station PAPA;

Start of Observations: 1954

End of Observations: ONGOING

Custodian: Robin Brown, Oceanographic Data Manager, Institute of Ocean Scien

Publication: Tabata, S. and W.E. Weichselbaumer. 1992. An update of the statistics of hydrographic/CTD data taken at Ocean Station P (May 1956-September 1990). Can.Data Rep. Hydrogr. Ocean Sci, 107: 75pp (and others)

Data Distribution: Included in the IOS/OSAP Archives of water properties and available on the DATA_LIBRARY disk. Search tools exist to select data by user-specified criteria.

Utility for Stock Assessment: Much of this data (prior to 1990) is included in the NODC World Ocean Atlas 1994.

Potential Improvements: prepare summarized data, including climatological mean profiles (by season or by month) and anomalies.

Internet/URL: http://www.ios.bc.ca

Contributor: Robin Brown

Offshore meteorological/oceanographic buoys - Canada

Data Category: PCO **ID:** 4

Parameter: Sea Surface Temperature, Wave Height and Period

Frequency: hourly

Measurement Details: 16 offshore, coastal and inshore moored buoys with on-board data loggers and telemetry via GOES; onboard calculation of significant wave height and peak period. Various starting dates, beginning as as early as 1988

Geographic Area: Canadian Pacific Coast and offshore waters 48 - 54 deg N 122 - 139 d

Start of Observations: various, starting as early as 1

End of Observations: ongoing

Custodian: Robin Brown, Oceanographic Data Manager, Institute of Ocean Scien

Publication: Technical details on data processing, calibration etc are available in "Meteorological and Oceanographic Measurements from Canadian Weather Buoys - a Review of Senors, Data Reduction, Transmission, Quality Control and Archival Methods", 1996. Prepared by Axys Environmental Consulting Ltd. for Environment Canada. Copy in IOS Library Technical Records.

Data Distribution: Historical have been assembled from various sources (MEDS and PWC) and are available at IOS. [Share_data disk: \METBUOY]. Real-time data are received at IOS and eventually replaced by data from AES that has been through their QC/QA procedures.

Utility for Stock Assessment: Data are archived at their original sampling interval (hourly). There have been subjected to AES quality control, but there are gaps in the data due to sensor or system failures. We have not assembled daily or monthly summaries of these data. Real time data (unverified by AES) are available at IOS.

Potential Improvements: Data are archived at their original sampling interval (hourly). There have been subjected to AES quality control, but there are gaps in the data due to sensor or system failures. We have not assembled daily or monthly summaries of these data. Real time data (unverified by AES) are available at IOS. Some additional work is required to merge data formats (particularly "time" coding). Processes could be developed to automatically generate daily and monthly summary files, which are likely to be more relevent for stock assessment use. In addition, we could attempt to reconstruct the time series BACK in time by extracting data at these locations from the COADS or REYNOLDS datasets.

Internet/URL: http:/www.ios.bc.ca

Contributor: Robin Brown

SST Temperatures- Blended data from Satellite Images and ships/buoys

Data Category: PCO **ID:** 96

Parameter: Sea Surface Temperature (SST)

Frequency: monthly

Measurement Details: R. Reynolds (Climate Analysis Center, Wash., D.C.) computes two arrays of SST monthly. One is an optimal blend of direct observations filled out with AVHRR imagery, the second includes only direct measurements. The "blended" dataset is available on a 2 degree x 2 degree grid from 1981 to present. The "direct observations only" is available on a 1 degree x 1 degree grid from 1956 to present.

Geographic Area: global

Start of Observations: 1956 (2 deg x 2 deg);1981 (1

End of Observations: ongoing

Custodian: Climate Analysis Center, Washington, D.C.

Publication: Reynolds, R.W. and T.M. Smith, 1994. Improved global sea temperature analysis using optimal interpolation. J. Climate 7, 929 - 948

Data Distribution: available by ftp from the Climate Analysis Center.
ftp nic.fb4.noaa.gov/pub/ocean/clim1/oimonth/ (for 1 deg x 1 deg data)
ftp nic.fb4.noaa.gov/pub/ocean/clim1/rsst/ (for 2 deg x 2 deg data)

Utility for Stock Assessment: Thsi is probably an underutilized resource. If we believe that ocean tempaertures affrect salmon behavious, then this is a critical data set.

Potential Improvements: Provide these data on our web site or publically available directory. Provide simple tools to extract time series for areas or points of interest. Use these datasets to reconstruct SST at offshore buoy sites.

Internet/URL:

Contributor: Howard Freeland

Satellite Images of SST - California to Beaufort Sea

Data Category: PCO **ID:** 93

Parameter: SST from AVHRR

Frequency: ~2 per day

Measurement Details: SST measurements from AVHRR instrument on polar orbitting weather satellites. Spatial resolution is about 1 km (at nadir). Cloud cover is a SERIOUS limitation to this data set. Calibration of satellite data to actual sea surface temperature values requires some "ground-truth" (can be provide from the buoy system). Satellite pass images are reviewed and rectified images are produced for selected areas when cloud cover permits. Cloud cover makes the data archive heavily biased towards summer images.

Geographic Area: California coast to Beaufort Sea

Start of Observations: 1990 (?)

End of Observations: ongoing

Custodian: Jim Gower, Ocean Sciences and Productivity Division, Institue of Oce

Publication:

Data Distribution: Searchable database of images (by time, area) available at IOS. Images are retrieved from off-line storage on request.

Utility for Stock Assessment: Limited use (directly) in stock assessment. Satellite images provide areal coverage that is helpful in intepreting the significance of "fixed point" measurements such as lighhouse or buoy measurements.

Potential Improvements: On-line searchable inventory of images would be useful, particularly if low-resolution"quick look" images could be incorporated.

Internet/URL:

Contributor: Robin Brown